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ABSTRACT

The instructional materials developed on power mechanics are based on the concept of performance objectives as organized by EPIC Diversified Systems Corporation. Objectives within the document are divided into four categories; (1) program objectives, (2) performance objectives, (3) process objectives, and (4) activities. These are categorized by a numbering system preceding each objective or activity. This identification system allows immediate identification of the objectives covered and assists in establishing a Project Monitoring System (PMS). The first 11 pages of the document give a brief description of the 15 program objectives; a list of the tools, materials, and equipment needed; and a short orientation program. The remainder of the document is divided into power mechanic units which are comprised of evaluation materials, worksheets, guides, tests, and a bibliography preceded by a list of equipment, films, and other supplies to be used in each unit. A three-page general bibliography is included. (BP)

NATCHITOCHES CENTRAL HIGH SCHOOL

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WE ARE GEARED FOR
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MECHANICS

NATCHITOCHES LOUISIANA

CE 001 647

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Introduction

The materials you are about to use were developed in the summer of 1972 by teachers experienced in teaching the subject areas involved. These materials were developed with respect to the concept of performance objectives as organized by EPIC Diversified Systems Corporation of Tuscon, Arizona. EPIC was retained by the Natchitoches Parish School Board to serve as monitor and evaluator of this Interest-Based Curriculum.

The instructional materials developed in English, mathematics and science correlate the vocabulary, terminology, concepts and skills of power mechanics to each academic area involved. For the sake of consistency, the format utilized herein contains certain symbols and abbreviations as instructional guides.

Objectives within the documents were divided into four categories; (1) Program Objectives; (2) Performance Objectives: (3) Process Objectives; and (4) Activities. These are categorized by the numbering system preceding each objective or activity. For example, the number sequence 8-1-3 refers to: Performance Objective number eight, signified by the first numeral; process objective number one, represented by the second numeral; and activity number three, indicated by the third numeral. The numbers in parenthesis beneath each sequence $\underset{(2,7,4)}{8\text{-}1\text{-}3}$ indicate the Program Objectives, to which each Process Objective relates. This identification system allows immediate identification of the objective(s) covered and assists in establishing a Project Monitorial System, referred to by the abbreviation PMS.

These courses of study are designed to be as inclusive as possible. Included are all activities with which a student will be involved in a teaching situation, along with many of the evaluation materials, worksheets, guides, and other materials that will be used. Each unit or topic is terminated by a bibliography preceded by a list of equipment, films and other supplies.

Copies of these materials may be obtained from the Louisiana State Department of Education. If not available there, they may be secured by writing to:

Mr. Trent Melder, Coordinator
Natchitoches Central High School
Natchitoches, Louisiana 71457

Cost is $2.50 per booklet to cover expenses involved in preparation, handling and shipping.

Foreword

Within the pages of this document are contained the efforts of a group of teachers to develop curricula materials or Power Mechanics. The purpose of these efforts is twofold. First, it is the opinion of those involved that Power Mechanics should be taught to students in a way that is both useful for their future aspirations and meaningful to them as citizens of our community, state, and nation. Second, by utilizing an interest-based curriculum, it is felt that the interest of students in academic areas will be heightened, thereby improving their achievement in those subjects involved.

This course of study is not an adaptation of the traditional course or courses in Power Mechanics to a level compatible with the achievement of students involved. Quite the contrary is true. Every effort has been expended to assure that basic concepts and ideas of Power Mechanics and other topics involved have been included. Utilizing this approach to the teaching of Power Mechanics opens to students two possibilities upon graduation. First, they will be able to utilize the skills gained in power mechanics to enter actively into a vocation. Second, should their aspirations include post-secondary study, the knowledge gained through the correlated academic classes opens this door to them also.

Development of the materials contained herein was most difficult and time-consuming, however, the results are immeasurably rewarding. The opportunity to develop these and other materials was made possible by an ESEA Title III Grant. Our thanks are extended to the Louisiana State Department of Education for its assistance and encouragement.

Teachers involved in the development of these materials include the following:

Mr. Clarence Snowden	Natchitoches Central High School
Mr. Clemon Nora, Jr.	Campti High School
Mr. John Vandersypen	Natchitoches Central High School
Mr. Jack M. Grigg	Natchitoches Central High School
Mr. Noble Butler	Former Principal of Natchitoches Parish School Board

POWER MECHANICS (P.M.)

Program Objectives

1. Upon the completion of the year 1972-73, the Power Mechanics students will demonstrate a 70% increase in knowledge of Orientation as measured by a teacher-made test.

2. Upon the completion of the year 1972-73, the Power Mechanics students will demonstrate a 70% increase in knowledge of Shop Safety as measured by a teacher-made test.

3. Upon the completion of the year 1972-73, the Power Mechanics students will demonstrate a 70% increase in knowledge of Tools and their Function as measured by a teacher-made test.

4. Upon completion of the year 1972-73, the Power Mechanics students will demonstrate a 70% increase in knowledge of Preventive Maintenance as measured by a teacher-made test.

5. Upon the completion of the year 1972-73, the Power Mechanics students will demonstrate a 70% increase in knowledge of the Electrical System as measured by a teacher-made test.

6. Upon the completion of the year 1972-73, the Power Mechanics students will demonstrate a 70% increase in knowledge of the Fuel System as measured by a teacher-made test.

7. Upon the completion of the year 1972-73, the Power Mechanics students will demonstrate a 70% increase in knowledge of the Exhaust System as measured by a teacher-made test.

8. Upon the completion of the year 1972-73, the Power Mechanics students will demonstrate a 70% increase in knowledge of Tune-Up Procedures as measured by a teacher-made test.

9. Upon the completion of the year 1972-73, the Power Mechanics students will demonstrate a 70% increase in knowledge of General Engines as measured by a teacher-made test.

10. Upon the completion of the year 1972,73, the Power Mechanics students will demonstrate a 70% increase in knowledge of the Braking Systems as measured by a teacher-made test.

11. Upon the completion of the year 1972-73, the Power Mechanics students will demonstrate a 70% increase in knowledge of the Front Suspension System as measured by a teacher-made test.

12. Upon the completion of the year 1972-73, the Power Mechanics students will demonstrate a 70% increase in knowledge of Transmissions as measured by a teacher-made test.

13. Upon the completion of the year 1972-73, the Power Mechanics students will demonstrate a 70% increase in knowledge of the Drive Line as measured by a teacher-made test.

14. Upon the completion of the year 1972-73, the Power Mechanics students will demonstrate a 70% increase in knowledge of Differentials and Rear Axles as measured by a teacher-made test.

15. Upon the completion of the year 1972-73, the Power Mechanics students will demonstrate a 70% increase in knowledge of Air-Conditioning as measured by a teacher-made test.

GENERAL TOOLS, MATERIALS AND EQUIPMENT FOR UNITS I-XV

Air Condition Tool Kit
Air Condition Unit (Complete) Auto
Alternator
Ammeter
Automobile (Complete)
Automobile Repair Manuel
Balancers
Battery-6 volt
Battery-12 volt
Bearing Drive on Punch
Bearing Puller
Booster Cylinder
Brake Fluid
Brake Shoes
Braking System Model
Car Stands
Chalk Board
Charts
Cleaning Solvent
Compression Gauge
Compression Tester
Concentric Valve-Seat Grinder
Creeper

3/4

Cylinder Head Assembly

Cylinder Leakage Tester

Dial Indicator

Disc Brake

Distributor/Contact Point

Distributor/Magnetic Pickup

Distributor/Transistorized System

Drain Pan

Engine Block (Assembly)

Engine Stands

Exhaust Gas Analyzer

Exhaust System (Complete)

Filmstrips

Finder Cover

Flask

Floor Jack

Freon

Fuel System (Complete)

Gas Engine (small)

Gasoline

Generator

Grease Seal

Hand Tool Kit

Headlight Tester

Hex-Head Bolt

Horn Relay

Hunter's Tune-in Wheel Balance

Hydometer

Hydraulic Jack

Ignition Analyzer #514 (King Tester)

Jack

Leak Detector

Lift (Hydraulic)

Lock Washer (plain, external, internal, external-internal)

Manufacturer's Manuals

Master Cylinder Cap/Special Tool

Master Cylinder (dual & single)

Mechanic Towels

Mechanic's Tool Kit

Micometer

Muffler

Multiple Cylinder Engine

Oil Can Opener

Oil Pan Wrench

Phillip Head Screwdriver

Projector

Rear Axle Assembly

Rear Axle (Special Tool Kit)

Run-out Gauge

Safety Stands

Seal Beam Headlight (#560 & 561)

Self-Adjusting Brakes

Shock Absorbers

Slides

Solenoid

UNIT I

ORIENTATION

1-0-0 Upon completion of the job the students will apply their knowledge of the power mechanics orientation by scoring 70% or above on a teacher-made test.

1-1-0 The project teacher during one class will define power mechanics as monitored by the project monitoring system.

1-1-1 Discuss the definition of Power Mechanics. (Handout 1-1-1)
1-1-2 Describe a mechanic by using the technical definition of a mechanic. (Bottom of handout 1-1-1)

2-0-0 At the end of the job the students will apply their knowledge of the location of plant facilities and course requirements by scoring 70% or above on a teacher-made test.

2-1-0 During one class the project teacher will test course requirements and position of facilities as monitored by the project monitoring system.

2-1-1 Students will tour the facility with the instructors pointing out the areas of the shop.
2-1-2 Students will be shown location of washroom, dressing area, tool area, and the fire extinguishers.
2-1-3 Describe the time table requirements for their particular class.
2-1-4 Discuss the grading scale and answer any questions.
2-1-5 Allow students to orient themselves to the shop.
2-1-6 Answer any question from the students.

3-0-0 At the end of the job the students will apply their knowledge of automobile accessories by scoring 70% or above on a teacher-made test.

3-1-0 The project teacher during one class period will discuss information sheet containing many different types of automobile accessories as monitored by the project monitoring system.

3-1-1 Discuss the use of a typical automobile owners guide.
3-1-2 Ask students to list different accessories available on modern automobiles.
3-1-3 Allow the students to describe any accessories which could make driving safer. (Handout 3-1-3)
3-1-4 List some steps in the care and maintenance of these accessories.

4-0-0 Administer test over 1-0-0 through 3-0-0 Orientation.

7/6/9

1-1-1 Handout - Definition of Power Mechanics

Power mechanics is the study of the rate of expanding, transmitting, and developing energy in the forms of natural, mechanical, steam, pneumatic, hydraulic, electrical and thermal power to control its potential to produce work.

natural - produced by nature such as coal, oil wind

mechanical - having to do with machinery

steam - water in the form of vapor or gas

pneumatic - having to do with air and other gases

hydraulic - science dealing with water and other liquids in motion

electrical - having to do with electricity

thermal - having to do with heat

Definition of a mechanic - A skilled workman who makes, repairs, and assembles machinery or mechanical parts.

3-1-3

AUTOMOBILE ACCESSORIES

1. Air conditioner
2. A M Radio - Solid State
3. F M Radio
4. Bumper guards
5. Carpeting
6. Console
7. Deluxe wheel covers
8. Electric Clock
9. 4 Speed manual transmission
10. Heavy duty suspension
11. Inside hood release
12. 3 Speed manual floor shift
13. Automobile transmission
14. Variable speed windshield wipers
15. Vinyl room
16. Tinted glass
17. Power steering
18. Positive traction
19. Power disc brakes
20. Racing mirrors
21. Rear window defogger
22. Luggage rack
23. Sun roof
24. Power windows

25. Stereo and Cassette tape
26. Automatic headlight dimmer
27. Power seats
28. Tilt and telescope rim blow steering wheel
29. Wheel opening skirts
30. Auto speed control
31. Power door locks
32. Fender mounted turn signals
33. Electronic ignition system
34. Door edge protectors
35. Engine block heater
36. Mirrow manual & remote control
37. Power bucket seats
38. Rear seat speaker
39. Trailer hitch
40. Undercoating
41. Oil gauges, amp, water temp, cigarette lighter

4-0-0

STUDY QUESTIONS

1. Define:

   Power Mechanics

   Automobile Accessories

2. Discuss some reasons for studying power mechanics.

3. List 15 accessories which can be bought with a new automobile.

4. List 5 accessories which could help in a safer automobile.

4-0-0

TEST

POWER MECHANICS

1. What is a good specific gravity of battery electrolyte?
2. Define A.C. current.
3. Define D.C. current.
4. What regulates the voltage produced by an alternator?
5. What does an automobile ammeter measure?
6. Name three parts of a spark plug.
7. Explain the purpose of a relay.
8. List three parts of the cranking motor.
9. What happens to the drive pinion of the starter after the engine starts?
10. Define: Hydraulics

    Power Mechanics
11. Name four parts of the braking system.
12. List materials used in brake linings.
13. Name ten automobile accessories.
14. List five accessories which could help in having a safer automobile.
15. Why should old oil be allowed to drain?
16. What methods are used to keep the oil in the crankcase free from dirt and grit?
17. List what precautions should be taken when lubricating an automobile.
18. How would you clean an oil crankcase ventilator?
19. What type of oil is used in standard transmissions?
20. Why should all parts be washed and dried?
21. Why is the wheel rotated while adjusting the bearings?
22. What is a frozen bearing?

23. Does the axle shaft bearing need packing before installing?

24. What should be done to leather seals before they are installed?

25. Explain the effects a broken ground wire has on a sealed beam light.

26. What takes up the slack when the adjustment is loosened?

27. Define a light filament.

28. How can you identify the front from the rear of a muffler?

29. How can a tail pipe being burned out in front of the gas tank cause poor gas mileage?

30. What is the advantage of the independent suspension system?

31. How does the stabilizer bar work?

32. Why is wheel alignment important?

33. What measuring instrument can be used in measuring the diameter of a shaft?

34. Describe the procedure of taking a measurement with a micrometer.

35. Why is it necessary to time the valves?

36. Explain the purpose of a cam lobe.

37. List two types of valve lifters.

38. What is the purpose of an air filter or air cleaner for a carburetor?

39. What is meant by idle speed?

40. How often should air filters be serviced?

41. How is fuel level controlled in the carburetor?

42. What purpose does the muffler serve?

43. What is a torque multiplier? Where is one used in the automobile?

44. List the four stages or strokes of engine operation.

45. What are the two commonly used oil pumps?

46. What purpose does the gasket serve?

47. Name two types of oil filters.

48. You should never over-lubricate a generator. Why?

49. What advantage is there in making the propeller shaft in two pieces?

50. Why must the line be carefully balanced?

51. Why is the tune-up procedure more important for modern engines?

52. Name four meters found on the king ignition analyzer.

53. What does T.D.C. stand for in power mechanics?

54. What are the two basic types of axles?

55. _____________ _______________ is the central unit in which hydraulic pressure is developed in the braking system.

56. When using a dual master cylinder and the front system failed the __________________ portion of the system will stop the vehicle.

57. In a two piece drive line, a ______________ bearing must be used.

58. Most propeller shafts are solid. True or False?

59. The differential pinion gear will mesh with the _______________ gear in the differential.

UNIT II

SHOP SAFETY

1-0-0 At the end of the job, the students will apply their knowledge of school shop safety by scoring 70% on a teacher-made test.

1-1-0 The power mechanics instructor will emphasize during one class period shop safety as monitored by the project monitoring system.

1-1-1 Discuss general safety (Handout-General Safety Habits).
1-1-2 Discuss and emphasize
    (a) "No horse play"
    (b) Common sense is the best safety practice
    (c) Always think before you act
1-1-3 Demonstration of some do's and don'ts of shop safety
1-1-4 Demonstrate the safe use of the emery grinder.
1-1-5 Demonstrate safe way of jacking an automobile.
1-1-6 Discuss different flammable mixtures and their combustion temperatures.
    Handout: 1-1-6
1-1-7 Discuss with students the reasons for studying shop safety.

2-0-0 At the end of the job, the students will apply their knowledge of industrial safety by scoring 70% on a teacher-made test.

2-1-0 The Power mechanics instructor will discuss during one class period industrial safety which will be monitored by the instructor.

2-1-1 Show charts that many industries use to promote safe practices.
2-1-2 Discuss incentive programs used in some industries to induce safety.
2-1-3 Discuss the job of Safety Engineer in Industry.
2-1-4 A safety representative will come to lecture on how he maintains a safe shop.
2-1-5 Discuss accidents that happen most often in an industrial atmosphere. List any industrial accidents that have happened lately.
2-1-6 Discuss a newspaper clipping which describes an industrial accident.
2-1-7 Discuss what could have been done to prevent such an industrial accident.

3-0-0 Upon completion of the job, the students will demonstrate their knowledge of rules and first aid fundamentals by scoring 70% on a teacher-made test.

3-1-0 Project teacher will instruct each student in the correct method of filling out Data Sheets and Accident Forms as monitored by the instructor.

3-1-1 List the reasons for coming straight to the instructor if any injury occurs, no matter how many.
3-1-2 Handout Accident Forms and require all students to complete them.
3-1-3 Handout Information forms and require each student to fill in appropriate blanks.
3-1-4 Administer safety test to all students required before working.
3-1-5 Write a pledge to be safe while working in the shop.

4-0-0 Upon completion of the job, the students will demonstrate their ability to apply his knowledge of personal group safety by scoring 70% on a teacher-made test.

4-1-0 The project teacher during one class will discuss the Group Safety Administrators as monitored by the project teacher observation. (See Handout # 4-1-3)

4-1-1 Demonstrate the need of a safety foreman in a shop.
4-1-2 Discuss with students some safety hints they may have. (Handout: Practical Safety Hints.)
4-1-3 Handout: Detail Duties of Student Personnel Officers.
4-1-4 Discuss the duties of a general superintendent.
4-1-5 Discuss the duties of a recording clerk.
4-1-6 Discuss the duties of a tool checker.
4-1-7 Discuss the duties of a safety foreman.
4-1-8 Administer verbal quiz on personal group safety.

5-0-0 At the end of the job, the students will apply their knowledge of reporting an accident by scoring 70% on a teacher-made test.

5-1-0 The project teacher during one class will list the order of procedure to follow after an accident as monitored by teacher observation.

5-1-1 Discuss the importance of reporting to the teacher.
5-1-2 Use an overhead projector to show an accident report form.
5-1-3 Write short essay on how accidents occur.
5-1-4 Discuss the reasons for calling the accident to the attention of the principal.

6-0-0 Administer teacher-made test covering Interims 1-5.

GENERAL SAFETY RULES

1. Avoid leaning on a machine while idle or talking to someone.
2. Avoid running, punching or any other horseplay in the shop.
3. Keep your eye on the cutting part when operating the machine.
4. See that the machine is clear and ready for use before turning the switch.
5. Avoid overloading a machine by trying to take a cut that is deeper than the power will pull.
6. Avoid using saws, blades or other cutting parts that are dull.
7. Avoid talking to a machine operator while he is trying to run a machine.
8. Avoid talking to anyone while trying to run a machine.
9. Stand clear of possible flying parts while operating a machine.
10. See that the machine has sufficiently lubricated.
11. Do not enter the zone around a machine when the machine is being operated by another person.
12. Always wear a shop apron or coat.
13. Keep your work bench clean and clear of extra parts and tools.
14. Return unused hand tools to the tool panel.
15. Avoid all horseplay in the shop.
16. Help your fellow classmate in handling heavy parts and tools.
17. Wear goggles when operating a machine that throws metal particles or chips.
18. Never light a match or use an open flame around flammable liquids.
19. Place rags and paper that have been soaked with cleaning material in a metal container with a tight fitting lid.
20. Students are warned not to use the metal working machines until they have been given proper safety instructions by the shop instructor.
21. All safety guards must be kept in their proper position while machines are being operated.
22. Machines must be allowed to come to a dead stop before any adjustments are made.
23. Report all tools and machines that are not functioning properly to the instructor.
24. Use tools only for their designed purpose.
25. Develop a respect for tools and power machinery. They will serve you well if handled properly.
26. Obtain permission from your teacher before starting a engine whether the engine is in a test stand or in a car.
27. Check fuel lines for leaks.
28. Vent exhaust tc the outside of building and provide adequate ventilation whenever running an engine whether engine is in a test stand or in a car.
29. Keep your hands and head away from the revolving fan.
30. Be sure to block wheels of any mobile engine test stand you may use.
31. Use, when necessary, a carbon dioxide (CO_2) extinguisher for flammable liquid fires.
32. Obtain permission from your teacher before servicing or charging a storage battery.

33. Use proper instruments for testing a storage battery.
34. Avoid overfilling a battery especially if it is to be charged.
35. Use water and baking soda to clean off the tops of a battery.
36. Remove and transport a battery with a battery lifter.
37. Handle battery or acid with care, wash immediately any part of your body or clothing that come in contact with acid.
38. Wash hands immediately after handling a battery.
39. Wear goggles when using a charger.
40. Provide ample ventilation when using a charger.
41. Remove cell covers before charging a battery (unless the cover has other instructions upon them).
42. Keep open flame and sparks away from battery being charged.
43. Turn off charger before disconnecting leads from charger to battery.
44. Replace cell covers before moving battery.
45. Store flammable liquids in a fireproof room or cabinet.
46. Bring into the shop only sufficient flammable liquid for immediate use. Keep only in safety container approved by the Underwriters Laboratory label container with names of contents.
47. Use only approved cleaning solution.
48. Avoid contact of carbon-removing or paint-stripping compounds with your skin.
49. Place rags containing oil and gasoline paint solvents and other combustibles in designated metal containers.
50. Keep the top of oil drums and surrounding area clean and free of combustible materials.
51. Dispose of unwanted flammable liquids and combustible material daily.

ELECTRIC EXTENSION CORDS AND ALL PORTABLE TOOLS

1-1-6

1. See that extension cord is of sufficient length.
2. Check cord to see that he is not frayed, nicked, or any insulation broken.
3. Check to see that both male and female plugs are in good condition.
4. Use only cords that have provision for being grounded.
5. Attach ground wire.
6. Check all portable tools carefully, trigger switches, cords, etc.
7. Be sure your portable tools are grounded.
8. Do not handl portable tools with wet hands.
9. Do not stand on damp ground or concrete when using portable tools.

WRENCHES

1. Always use the proper wrench when making adjustments on machines.

AMERICAN STANDARDS ASSOCIATION
Safety color code

RED-- THE FIRE PROTECTION COLOR

General use: To point out the location of fire protective equipment such as extinguishers, alarms, firedoors, fire blankets, etc.

Pipes: Sprinkler or other fire extinguishing system pipes.

ORANGE--THE ON-GUARD COLOR

General Use: To indicate dangerous parts of machinery which could injure personnel by cutting, crushing,
For electrical hazzards such as interior of fuse and switch box doors. Interior side of gear guards.

Pipes: Pipes containing materials which are poisonous, hot, easily ignited, explosive, or otherwise dangerous.

YELLOW--THE WARNING COLOR

General Use: To point out conditions or installations which are likely to cause bumping, stumbling, tripping, or falling. Used as a band when making busy aisles, moving objects overhead, etc.

Pipes: Same as for orange.

GREEN--THE FIRST AID COLOR

General Use: To mark location of first aid and safety equipment such as medical kits, stretchers, respiratory and eye equipment, safety showers, etc.

Pipes: For pipes handling safe and non-valuable products such as water, air (under 300 lbs.), sugar solutions, etc.

BLUE--THE CAUTION COLOR

General Use: A precautionary warning to indicate that materials should not be in use, moved or started except by qualified personnel, such as for temporary repairs. Sometimes used electrical control boxes.

Pipes: For protective materials other than fire protection, such as gases to counteract poisonous fumes, antidoted to dangerous Mats.

WHITE--ZONE MARKING COLOR

General Use: To direct the flow of traffic and to accentuate sanitation equipment, such as traffic lanes, non-hazardous aisle markings, waste receptacles, storage areas, corners.

Pipes: Safe materials. Same as green

PURPLE--NUCLEAR RADIATION HAZARD COLOR

General Use: To indicate nuclear radiation hazards. In common use is a three spot triangular magenta against a yellow background.

Pipes: To indicate that the contents is of extra value and udually is non dangerous.

Benefits of using color in industry

1. Less absenteeism from the job.
2. Increased morale and the worker's attitude.
3. Fewer accidents, hazards identified with color
4. Improved quantity and quality of production.
5. Better employee relations.

FLAMMABLE LIQUIDS

Definition of terms:

Flammable liquids--or inflammable liquids (used synonymous) refer to materials that are susceptable to ignition.

Flash point--"The temperature at which the vapor given off from an oil or hydrocarbon will ignite momentarily in the air, in the presence of a small flame."

The following information has been taken from the National Fire Protection Association International Fire Prevention Handbook. Where direct quotes have been made of pertinent information included in the handbook on this topic.

Unsafe Storage Evaluation

In evaluating storage facilities for safety measures, check the following:

1. Leaky valves--each drop that goes unattended is a fire hazard.
2. Be sure all vents are operating properly.
3. If gauging devices are used, be sure no leaks are present around or within the gauge.
4. All filling lines and holes should be properly capped.
5. Be sure that plenty of fresh air circulation is available around storage area. (If stored in a building, vents to the outside of the storage room should be plentiful.)
6. Storage should be a minimum of 20 feet from any type of flame, or heat (preferrably farther, depending upon type of liquids being stored and facilities housing the liquids.)
7. All liquids should be stored in a fire proof cabinet or container designed for that purpose.

Storage of Flammable Liquids

1. Never store more than necessary for immediate use.
2. Allow plenty of room around stored containers for air to circulate freely.
3. Always leave plenty of room for expansion in stored cans.
4. If temperature rises any appriciable amount, it is advisable to check cans to see that they do not have too much pressure creating a hazard. (If cans are puffed up, loosen lid carefully, releasing pressure.)
5. Store only the amount to be used immediately in room where liquids are to be used. This small amount should be stored in a steel cabinet or chess type of storage for maximum safety.

Outside Storage (2,7-30)

1. If any great amount of flammable liquids are to be stored, store them away from the building. The closeness of the building to other buildings would depend upon the type of construction of the buildings and the flammability of the liquids to be stored.
2. In storing drums, store vertically if liquids are to be used and dispense them with a pump.
3. If liquids are not to be used, store drums in a horizontal position on 4" x 4" runners to allow maximum air circulation.
4. Building should be equipped with a fire resistant wall and door, and with safety lights and switches.
5. If blower or suction fans are used, motors should be outside of the passage of vapors given off from the liquids. Fans should be driven by belts or shafts and not directly.
6. Paint building a light color if all possible. This reflects the heat from the sun more readily.
7. If drums are stored outside (or large tanks are used), paint then silver to reflect the greatest amount of heat possible.
8. Post signs around storage area designating danger involved in and around storage area.

Dispensing and Handling Method (2, 7-32)

The hazard is not in storing flammable liquids so much as it is in the interval between the storage and the actual use of the liquids. In other words, the transferring of the liquids from the storage facility to the area in which the liquids are to be used.

1. In dispensing liquids, a positive displacement pump should be used if the container is too large to safety tilt and pour liquids.
2. If electric pumps are used, they should meet the standards set up by the National Safety Council or the NFPA.
3. Liquids should be transferred in approved containers, and under no circumstances should glass containers be used.
4. After liquids have been used, they should be capped and safely stored.

Cleaning Containers for Repairs (2, 7-85)

If containers are to be repaired by heating. they can be prepared for safe repairs by:

1. Filling with water, leaving vent open for air.
2. Steam cleaning, or
3. Filling with an inert gas such as CO_2 leaving an opening for fumes to be carried out by the CO_2.

Brush Painting and Spraying (2,7-36)

There are two major methods of painting. They are brush painting and spray painting.

1. Brush painting in itself is virtually free frim accidents, but the combustion deposits of flammable liquids on wiping rags is the main danger involved here. All rags should be placed in a safe container and disposed of daily.

2. Spray Painting. One of the major factors in safe spray room painting is ventilation. This is necessary to the health of the person using the room as well as to reducing the hazard of fire.

   a. Select a finish or solvent which a flash point above 100°F if at all possible.
   b. Spray booths, if used, should be constructed out of metal and should have an exhaust fam for removing spray fumes and harmful gases.
   c. Exhaust fan motors should never be located in the spray booth orduct work. They should be located outside and either driven by belt or shaft.
   d. Only approved lighting and switches should be used in the spray room.
   e. When cleaning the spray booth or room, wet entire area with water. The residue collected in the booth is highly combustible and could very easily be ignited by a spark from a paint scraper.

FLAMMABLE LIQUIDS OFTEN FOUND IN THE INDUSTRIAL OR VOCATIONAL SHOP (2, 6-130)

The following are some of the flammable liquids found in the industrial or vocational shop. In order to better understand the degree of danger involved in suing and storing these liquids, the flash point is included for comparison purposes.

Type of Liquid	Flash Point (Degree F.)	Effectiveness of Water as an Extinguishing Agent
Acetone	0°	Water ineffective
Alcohols		
Denatured	60°	Water ineffective
Ethyl	55°	Water ineffective
Methel	52°	Water ineffective
Amyl Acetate (Banana oil)	72°	Water ineffective
Benzine (Naphtha)	0°	Water ineffective
Benzol (used in most paints)	12°+	Water may be effective as a blanket effect
Linseed oil	403°	Water usually ineffective
Mineral spirits (turpentive substitue)	104°	Water usually ineffective
Turpentine	104°	Water usually ineffective

For flammable liquids not listed above, consult your fire department.

Flash point may be defined as "the temperature at which the vapor given off from an oil or hydrocarbon will ignite momentarily in air, in the presence of small flame." (1, 173)

1-1-6c

CHARACTERISTICS OF TWO MOST COMMONLY USED FIRE EXTINGUISHERS USED IN INDUSTRY AND AT HOME

TYPE		DRY CHEMICAL	CARBON DIOXIDE
Method of Operating		Squeeze Lever	Squeeze lever
Method of Discharging Extinguishing Agent		Stored Air Pressure	Pressure Stored in Cylinder
Rated Capacity of Most Common Size		20 lbs.	15 lbs.
Effective range of Stream		15 to 20 feet	6 to 8 feet
Approx. Duration of Discharge at Room Temp.		11 seconds	18 seconds
Nature of Principal Extinguishing Agent		Dry Chemical	Carbon Dioxide Gas and Snow
FOR USE ON CLASS A FIRES	Wood, Paper Textiles, Rubbish, etc.	Will extinguish flame and retard burn back. However, quenching agents are more effective on deep-seated fires.	NO Cooling and quenching agents are more effective on deep-seated Class "A" fires.
FOR USE ON CLASS B FIRES	Gasoline, Oil Greases, etc. Flammable Liquids not derived from Alcohols	YES Not subject to freezing. Ideal for spill or running and dripping flammable liquid fires.	YES Not subject to freezing. Ideal for running or dripping flammable liquid fires.
	Acetone, Ethers Alchols and Kindred Liquids	YES Excellent for incipient fires in flammable Liquids Kindred to Alcohols.	YES Excellent for incipient fires in flammable liquids kindred to Alochols.
FOR USE ON CLASS C FIRES	Electrical Machinery	YES Discharge is a non-conductor, has no wetting, no solvent effect.	Discharge is a non-conductor, has no wetting, no solvent effect and leaves no residue.

FOR USE ON CLASS D FIRES	Pleasure Automobiles	YES because it has a smothering effect and is not subject to freezing.	because it has smothering effect and is not subject to freezing.
- - - -	- - - - -	- - - - - - - - - - - -	- - - - - - - - -
D-T FIRES	Commercial, Land and Trailer Trucks	YES because it has a smothering effect and is not subject to freezing.	because it has a smothering effect and is not subject to freezing.
Principal Extinguishing	Effect	Smothering	Smothering

STANDARD STUDENT ACCIDENT REPORT FORM

3-1-2

Part A. Information on ALL accidents

NAME ____________________ HOME ADDRESS ______________

SCHOOL ____________________ SEX: M___ F___ AGE___ GRADE _____

Time accident occured: Hour ______ A.M. ____ P.M. Date ____________

Place of Accident: School Building _____ School Grounds____ Home ______

To or from school ____ Elsewhere ________

Nature of Injury

Abrasion___ Fracture___
Amputation___ Laceration___
Bruise ___ Puncture___
Concussion___ Sprain___
Cut_____
Other (specify)
____

How did accident happen? What was student doing? Where was student? List specifically unsafe conditions existing. Specify any tool, machine or equipment involved.

Part of Body Injured

Ankle___ Hand____
Arm____ Head____
Back____ Knee____
Elbow___ Leg_____
Eye_____ Nose____
Face____ Scalp___
Fomger__ Tooth___
Foot____ Wrist___
Other (specify)
____

Degree of Injury: Death _____ Permanent Impairment ______
Total number of days lost from school ______ (To be filled in when student returns to school)

PART B: ADDITIONAL INFORMATION ON SCHOOL JURISDICTION ACCIDENTS

Teacher in charge when accident occured (Enter Name)________________
Present at scene of accident: no___ yes___

Immediate Action Taken

First-aid treetment _____ By (Name)________________
Sent to school nurse ____ By (Name)________________
Sent home __________ By (Name)________________
Sent to Physicial_______ By (Name)________________
Sent to Hospital_______ By (Name)________________
Name of Physician______________ Name of Hospital____________

Was a parent or other individual notified? No___ Yes___ When_____ How______

Name of individual notified: ______________________________

LOCATION SPECIFY ACTIVITY REMARKS

What recommendations do you have for preventing other accidents of this type?

Athletic field____________________
Auditorium____________________
Classroom____________________
Corridor____________________
Dressing Room____________________
Gymnasium____________________
Home Econ.____________________
Laboratories____________________
Sch. Grounds____________________
Shop____________________
Showers____________________
Stairs____________________
Others____________________

Signed: Principal:____________________

Teacher:____________________

4-1-2

SOME PRACTICAL SAFETY HINTS*

1. Gasoline is dangerous - treat it with care and respect.

2. A fan can inflict serious injury. Keep hands, tools, etc. away from the fan

3. Be very careful when removing the cap from the radiator of a pressurized system. Open the cap to the first stop, wait a few seconds and then remove cover cap with a rag. During this operation, keep face away from steam. When the pressure is suddenly removed from one system, it can cause superhot steam, and will escape in a violent fashion, be careful.

4. Carburetors are occasionally primed when dry, by pouring a small amount of gasoline down the air horn. Never do this with the engine being cranked. Do not spill gasoline on the engine. Before trying to start, put away the priming gas can and stand well back.

   Never place your hand over the air horn to choke the engine. A backfire through the carburetor could turn you hand into a most unsavory hamburger, well done!

5. Engine removal and installation can be quite dangerous. Make certain that all lift equipment is in good condition. Secure the lift strap or chain with strong bolts with the bolt thread turned in deeply. If a stud is used, make sure the nuts are screwed on far enough to hold.

   Mount the puller strap to a spot that will withstand the puller strain and that will allow the engine to balance.

   When pulling or installing, keep clear of the engine at all times. Watch hands and fingers when guiding in or out.

   Place engine on the floor or on an engine stand immediately. Never work on an engine that is supported in mid-air by the lift.

   Remember, engines are heavy and must be handled with utmost care!

6. In any vehicle used for competition, it is imperative that a scatter shield be used to protect the driver in the event of clutch failure!

7. Never work on a clutch assembly when in the car, without first disconnecting the battery. Otherwise, if the starter is accidently operated, severe damage could be inflicted on your hands.

8. When dismantling a front suspension system, make certain the control arm is secured to prevent it from slamming downward when disconnected. When either the inner or outer end is disconnected, the terrific force of the partially compressed coil spring is unclosed, and it will propel the arm downward with crucial force.

9. When supporting a car body while removing the rear axle, working on the suspension system etc., make certain the car is securely blocked. A car is heavy and can easily crush a careless mechanic. Block it safely.

10. When a wheel is removed and replaced, make certain the wheel lugs, nuts, etc. are tightened securely or the wheel may come off in service.

11. Always install safety washer and put in a new cotter pin when replacing a front wheel hub.

12. When inflating a tire mounted on a rim with a demountable rim flange (such as used on many trucks), always place a chain around the tire and wheel assembly. Face the demountable rim flange down or away. Make certain the rim is securely in the rim patter.

    When inflating such setups, these rims have been known to fly off with lethal force. Don't take chances.

13. The steering system is of critical importance in the safe operation of the car. It must be serviced and inspected on regular basis. Whenever repairs are made, make certain all parts fit, are properly adjusted, and are secured.

    If parts are bent or worn, never weld, heat or straighten and part. Throw it away. Under no circumstances cheat on safety!

14. Use high quality brake fluid only. Any mineral oil, such as kerosene, gasoline, etc., in even the smallest amounts, will swell and destroy the rubber cups in the system.

15. Battery electrolyte is a strong acid. It can be highly injurious to the eyes, skin and clothing. If accidently splashed with acid, flush affected area with large amounts of water. Follow immediately by bathing area in a mixture of baking soda and water. Soda being an alkali, will neutralize the acid. When working with batteries, be careful.

16. When holding small units in the hand, do not shove down on the screwdriver handle, as it may slip and pierce your hand. If working on electrical equipment, shut off the current, use an insulated screwdriver and keep your hands free of any wires where it is impossible to shut off the current.

AIR CONDITIONING

17. Keep the service area well ventilated.

18. Always wear protective goggles when working on or near an air conditioning system.

19. Keep sterile mineral oil and a weak boric acid solution on hand.

20. Keep refrigerant away from skin.

21. Avoid discharging refrigerant directly into the service area.

22. Never discharge the refrigerant into an area containing an open flame.

23. Never steam clean, weld, solder, brake body finishes or in any way, subject the air conditioning system to excess heat.

24. Never attempt to use a file as a pry bar and never hammer on it. The file is brittle and will break easily. If it is hit with a hammer, it is likely to shatter in a dangerous manner.

25. Grinding wheels can be broken by head blows, by heavy pressure, or by excessive tightening of the spindle nut.

26. Never attempt to adjust or oil moving machinery unless the instructions specifically state that this should be done.

27. Sodium is a highly reactive element. If a piece of sodium is dropped into water it will burst into flame with almost explosive violence. If it gets on the skin, it will cause deep and serious burns. Of course, as long as it is safely sealed in the valve stem, there is no danger. But if the hollow stem of a sodium cooled valve is cracked or broken, then it is potential dangerous. Old or damaged sodium valves should be disposed of in a safe manner. Some manufacturers recommend burying them underground. Not all sodium valves are marked, but then they can usually be recognized by their oversize stems.

28. Do not confuse viscosity and service ratings of oil. Some people think that a high viscosity oil is a heavy duty oil. This is not necessarily so. Viscosity rating refer to the thickness of the oil; thickness is not a measure of heavy duty quality. Remember that there are two ratings, viscosity and service. Thus, on SAE 10 oil can be an MS, MM, or ML oil. Likewise, an oil of any other viscosity rating can have any one of the three ratings MS, MM, of ML.

> When you think you know it all...You stop growing. It will not be long until the job at hand stands like a giant in relation to your ability to perform it. When this happens, your usefullness as a mechanic is gone.

Crouse, William H., Automobile Mechanics. New York: McGraw Hill Book Co., 1956. Pg. 36, 47, 49, 128, 190.

Stockel, Martin W., Auto Mechanics Fundamentals, Homewood, Illinois. Goodheart-Willcox Co., Inc., 1969. Pg. 8, 81, 85, 137, 165, 197, 287, 289 298, 299, 303, 336, 343, 375, 436, 402, 420.

4-1-3 DETAILED DUTIES OF STUDENT PERSONNEL OFFICERS

The purpose of setting forth the duties of the various student personnel officers is to: (1) conserve time, (2) to give the students an opportunity to serve in positions of responsibility, (3) to simulate a realistic industrial personnel organization, (4) to keep the shop or laboratory clean, orderly, and in good working condition conducive to good learning situations. The officers in this student personnel organization will consist of: (1) a General Superintendent, (2) a Recording Clerk, (3) a Tool Checker, and (4) a Safety Foreman.

GENERAL SUPERINTENDENT

Duties:

(1) Serve as an assistant to the instructor.

(2) General Supervision over the other officers and other members of the class.

(3) Change the Assignment Responsibility Clean-Up Chart at each designated period

(4) Preside at Grievance Committee hearings.

(5) Confer with Instructor on matters pertaining to the welfare of the class.

(6) Act as receptionist to greet visitors to the shop.

SUGGESTED CLASS ROUTINE OF GENERAL SUPERINTENDENT

(1) Rotate the responsibility of Assignment Clean-up Chart at a time designated by the Instructor.

(2) Explain the duties from the chart to all students so that all students understand their assignment and the purpose of that assignment.

(3) Call the class to order when the students have arrived in the laboratory at the beginning of each class meeting.

(4) Have the Recording Clerk check the roll and make the record of attendance according to the school policy and that of the Instructor. If the Recording Clerk is absent, the General Superintendent himself will perform the Recording Clerk's duties.

(5) Assist the Instructor by having tools and machines easily accessible for demonstrations, shop talks, discussion, etc.

(6) Work on own project until designated time for clean-up.

(7) Notify class that is is five minutes before time for dismissal by signaling with the buzzer.

(8) See that clean-up procedures are begun.

(9) Check on the final general clean-up of the laboratory by observation and call the class to attention for any possible last minute announcements.

(10) Dismiss the class in accordance with the policy of the Instructor.

RECORDING CLERK

DUTIES:

(1) Check the roll at the beginning of each class period and record absences on the proper forms.
Note: Tardiness is treated as an absence. Records of attendance will not be changed after the original check.

(2) Assist the Instructor in keeping the Progress chart up to date.

(3) Collect notebooks, reports, and other related materials when they are due.

(4) Notify the General Superintendent of those members absent so that temporary appointments for the day can be made to take care of the absent members' clean-up responsibility.

(5) Assist the Instructor in issuing instruction sheets and other pass-out materials.

(6) Work on own project until the end of the class period or until called upon for further duties by the General Superintendent or the Instructor.

TOOL CHECKER

DUTIES:

(1) Check tool panels and storage areas to see that all tools are in their proper places at the beginning of the class period.

(2) Check tools to see that they are in proper working conditions; for instance, check for broken handles, loose handles, chipped cutting edges, broken blades, etc.

(3) Check tool panels and storage areas at the close of the period to see that all tools have been returned to their proper places.

(4) Report to General Superintendent any tools which become damaged and/or misplaced.

(5) Make minor repairs and adjustments on tools during the class period as called upon to do so.

(6) Assist Instructor in checking out special tools and equipment from the supply room storage area. See that all such tools and equipment are returned to those special storage areas at the end of the class hour.

(7) When the clean-up signal is given, put away own work and proceed with the responsibility of seeing that all other students return tools and equipment to their proper storage.

SAFETY FOREMAN

DUTIES:

(1) See that the laboratory is lighted.

(2) Regulate ventilation.

(3) Control exhaust system.

(4) Study and learn fire drill regulations.

(5) Check fire extinguishers.

(6) Check first aid kit.

(7) Handle safety posters.

(8) Enforce laboratory rules pertaining to general shop safety.

(9) Report all accidents to Instructor immediately.

(10) In case of an accident, fill out necessary accident report forms. (see instructor)

(11) See that all students wear shop approns.

(12) See that all machines are properly guarded.

(13) Inspect the finishing area at the close of each class period. See that all cans and containers are properly closed, and all oily rags and papers are disposed of in a closed metal container.

(14) See that students refrain from throwing debris on the floor in aisles and passageways.

POWER MECHANICS

6-0-0 Safety Test

True or False:

1.__________Never lean on a machine while it is running.

2.__________Never run in the shop.

3.__________It is alright to talk to someone running a machine.

4.__________Running short stock through a machine is not dangerous.

5.__________You can never overload a machine by trying to take a cut too deep.

6.__________Always oil a machine while it is running.

7.__________Never sharpen a blade to be used very much.

8.__________Safety zones are useless in the shop.

9.__________Wearing a shop apron is dangerous.

10.__________Only clean up when you have finished your job.

11.__________Wait until you have finished your work before returning tools.

12.__________Never throw scrap pieces of stock on the floor.

13.__________Avoid all horse play in the shop.

14.__________Never help a fellow student with long heavy stock.

15.__________Wearing goggles is unnecessary when running a grinder.

16.__________Smoking in the shop is permissible.

17.__________Place rags soaked in cleaning material in an open can.

18.__________Any student can operate any machine in the shop without permission.

19.__________Always adjust machines while they are running.

20.__________Repair broken tools and machines on your own.

21.__________It is alright to use a screwdriver for a chisel.

22.__________Power machinery is dangerous even if used correctly.

Directions: Place the best word or words in the space provided.

1. When you are about to raise an engine or car by hoist or crane, you should be certain the object to be lifted is securely ______________________.

2. After raising a car by hoist or crane, you should support the car with blocks or ______________________.

3. When lifting an engine with a chain sling, you should be sure the sling is securely______________________.

4. Before getting under a raised car, you must obtain permission from the ______________________.

5. Before starting an engine, you should obtain permission from ______________.

6. When running an engine, you should vent exhaust to the outside of building and provide adequate ______________________.

7. When working on an engine that is running, you should keep your head and hands away from the revolving ______________________.

8. It is best to clean the top of a storage battery with water and baking _____.

9. After handling a storage battery, you should wash your ________________.

10. An open flame near a storage battery may cause an __________________.

11. Before disconnecting leads (wires) from charger to storage battery, you should turn off ___________________.

12. You should store flammable liquids in a room or cabinet that is____________.

13. When using carbon removing paint-stripping compounds, you should avoid contacting material with your ___________________.

14. You should place rags containing oil, gasoline, paint solvents, and other combustibles in a designated metal ______________________.

23.__________An automobile fan can inflict serious injury.

24.__________Always stand in line with the revolving fan.

25.__________Always remove the radiator cap as fast as you can.

26__________Cover the radiator with a rag and hide face when opening radiator.

27.__________Placing your hand over a carburetor horn is an acceptable way to choke your car.

28.__________It is a safe practice to work on an engine in midair.

29.__________Any vehicle used for competition should have a scatter shield to protect the driver from clutch failure.

30.__________Always block a car before working under it.

31.__________Always make certain all wheel lugs are tightened securely.

32.__________Always install a new coiter pin when replacing a front wheel hub.

33.__________Never weld a part on the steering system of a car.

34.__________Kerosine is a good high quality brake fluid.

35.__________Battery electrolyte contains Nitrio Acid.

36.__________Always dilute battery acid with water.

37.__________All screwdriver tips are the same size.

38.__________When you think you know it all you'll end up getting hurt.

Multiple Choice

Directions: Each of the following statements may be answered with the correct letter.

( ) 1. Before doing work under a car that has been raised, or before removing wheels, you should make sure the:
    (a) transmission is in neutral
    (b) car is adequately supported
    (c) car is raised enough for the use of a creeper
    (d) hand brake is applied

( ) 2. When you are about to raise an engine or car by hoist or crane, you should be certain the:
    (a) battery is disconnected
    (b) transmission is in neutral
    (c) hand brake is set
    (d) object to be lifted is securely tied and balanced

( ) 3. You should place crane or hoist directly over the object to be lifted so:
    (a) weight may be raised faster
    (b) crane, hoist or object will not tip over
    (c) there will be less wear on the chain
    (d) less room will be needed

( ) 4. After you have raised a car by crane or hoist, you should place sufficient support under the car so you will be sure the:
    (a) car will not roll away
    (b) strain will be eliminated on the springs and shock absorbers
    (c) hoist will last longer
    (d) car will remain in the raised position

( ) 5. You should place crane or hoist directly over the object to be lifted so:
    (a) weight may be raised faster
    (b) crane, hoist or object will not tip over
    (c) there will be less wear on the chain
    (d) less room will be needed

( ) 6. After you have raised a car by crane or hoist, you should place sufficient support under the car so you will be sure the:
    (a) car will not roll away
    (b) strain will be eliminated on the springs and shock absorbers
    (c) hoist will last longer
    (d) car will remain in the raised position

( ) 7. You should vent exhaust to the outside of building and provide adequate ventilation whenever running an engine because:
    (a) an engine needs this air to produce a proper mixture
    (b) the noise of the exhaust will be reduced
    (c) back pressure on the manifold will be lessoned
    (d) it will prevent the release of exhaust gas in the shop

( ) 8. When working on an engine that is running, you should
- (a) remove blocks from the wheels
- (b) keep the car in low gear
- (c) make sure the tank is full of gasoline
- (d) keep head and hands away from revolving fan

( ) 9. It is best to use a carbon dioxide (CO_2) extinguisher because:
- (a) it will extinguish flammable liquid fires
- (b) carbon dioxide can be mixed with the exhaust to reduce
- (c) carbon dioxide can be used to make the fuel richer
- (d) it can be used to cool the muffler

( ) 10. Before disconnecting leads (wires) from charger to storage battery, you should:
- (a) replace cell covers
- (b) check with tester
- (c) close windows
- (d) turn off charger

( ) 11. Gasoline should be kept in a safety container approved by the Underwriters Laboratory because:
- (a) the odor of gasoline makes some people ill
- (b) gasoline vapor is highly combustible
- (c) it will not evaporate
- (d) the container is difficult to trip over

( ) 12. You should use approved cleaning solutions instead of gasoline because:
- (a) gasoline does not clean as well as solvent
- (b) gasoline is too expensive to use for cleaning purposes
- (c) parts will be tinted by the red dye in lead gasoline
- (d) there is a danger of an explosion when using gasoline

( ) 13. Rags containing oil, paint, solvents, and other combustibles should be:
- (a) folded neatly and placed on a shelf
- (b) left on the workbench
- (c) thrown on the floor
- (d) placed in an approved metal container

This is to certify that I have received safety instructions in **Power** Mechanics My teacher has demonstrated to me how to operate each machine correctly and safely. I promise to observe all safety precautions and if ever in doubt regarding any operation, I will get the necessary information from my teacher.

Signed: ____________________

Date: ____________________

46/47/48

UNIT III

TOOLS AND THEIR FUNCTIONS

1-0-0 At the end of the job, the students will apply their knowledge of hand tools by scoring 70% on a teacher-made test.

1-1-0 For 45 minutes, the project teacher will lecture and demonstrate the use and types of hand tools.

1-1-1 Students will use socket set, ½' drive for heavy work.
1-1-2 Use socket set - 3/4' drive on small engine disassembling.
1-1-3 Discuss combination open-end and box-end wrenches and their uses.
1-1-4 Discuss torque. Tighten to specification.
1-1-5 The students will use open-end wrenches on both automobile engine and small engines.
1-1-6 Students will use the different types of wrenches after demonstration.

1-2-0 The project teacher will lecture and demonstrate the care and safety of hand tools.

1-2-1 Have students clean hand tools.
1-2-2 The student will find the proper tool for a specific job.
1-2-3 Require the student to use a greasy tool and compare its use to a clean tool.
1-2-4 Show film, Safety on Hand Tools.
1-2-5 Handout.

2-0-0 At the end of the job, students will apply their knowledge of fasteners by scoring 70% on a teacher-made test.

2-1-0 The project teacher will use automotive mechanics reference books to teach the knowledge of fasteners and their relationship to each other for 45 minutes as monitored by the project monitoring system.

2-1-1 Define fasteners.
2-1-2 The student will list different types of nuts, screws, bolts, and studs. (Handout 2-1-2)
2-1-3 Students will be required to know the different thread classes found on nuts and bolts.
2-1-4 Students will study the various types of screwheads.
2-1-5 Students will study the various lock washers and their functions. (Handout 2-1-5 and 2-1-5a)
2-1-6 Students will study the use of rivets and list types. (Handout 2-1-6)

3-0-0 At the end of the job, the students will apply their knowledge of test equipment by scoring 80% on a teacher-made test.

3-1-0 The project teacher will use the operating instructions manual for 90 minutes in teaching the students the use of test equipment, such as the King electronic engine tester timing light, pp. 29, Dwell Meter pp. 23, Idle test, alternator, Diode starter test, as monitored by the project monitoring system.

3-1-1 Read preparation for test and general function of King tester.
3-1-2 Place A.C. switch in on position.
3-1-3 Have students learn to plug the A.C. cord to the proper outlet.
3-1-4 Read function of King Scope.
  A. Perform preliminary adjustments to the controls of King Scope as outlined in manual.

  B. Set pattern selector to do play position.

  C. Set pattern selector to secondary position.
3-1-5 Have students to study the Tachometer.
  A. Set engine cycle selector to appropriate position several times.

  B. Turn engine R.P.M. selector to 1000RPM.

  C. Read related references.
3-1-6 Show students how to connect timing light and aim at proper place.
3-1-7 Require students to locate timing mark and pointer.
3-1-8 Have students to practice rotating distributor.
3-1-9 Study Dwell meter operation.
  A. Dwell meter consists of four scales.

  B. Three of the scales are divided in degrees to indicate 4, 6, 8 cylinder dweil.

  C. Study the 4th scale which ranges from 0 - 100 percent and indicates a corresponding percent of dwell. See dwell scale on machine.
3-1-10 Study the combustion meter.
3-1-11 Have students read the combustion from several engines or cylinders.
3-1-12 Have students study use and care of combustion tester such as:
  A. A combustion tester is a precision instrument.

  B. Never use the combination tester on an engine while gum solvents or oils are being introduced into combustion chamber through the carburetor.

  C. Do not use combustion tester on an engine that is burning oil badly. (Handout 3-1-12)

4-0-0 At the end of the job, the students will apply their knowledge of specialty and machine tools by scoring 70% on a teacher-made test.

4-1-0 The project teacher will provide activities in the use and care of the valve conditioning machine for 105 minutes, as monitored by the monitoring form.

4-1-1 Have students to write a report on valve-refacing machine. (ref.)

4-1-2 Have student to learn the following valve seat grinding operations.

A. Use a ¼" drill for driving wire carbon cleaning brushes in removing carbon from the engine block and cylinder heads.

B. To sharpen carbon brushes grind the wire ends square by holding the brush in an electric drill with the brush revolving against a running grinding wheel.

C. Inserting the pilot after the proper size pilot for the valve guide has been selected, the tapered sleeve on this pilot should be run out on its tread as far as possible. Then insert this pilot until its upper taper stops on the valve guide.

4-1-3 Install stone and sleeve on pilot.

A. Select stone in correct size.

B. Screw the stone tightly against collar of the sleeve.

C. Adjust the arm of the dressing stand so the angle dressed on the stone corresponds to the angle ground on the valve face.

4-1-4 Grind the valve seat.

A. While grinding support driver lightly to allow its vibrating mechanic to operate freely.

4-2-0 The project teacher will provide activities on the use and function of the Distributor Tester for 45 minutes as monitored by project monitoring system.

4-2-1 Mounting Distributor Operations

A. Standard Stationary distributors are mounted in V-Clamp

B. Rotating type distributors, require a bushing adapter to function properly. Insert correct accessory bushing adapter in V-Clamp and place distributor in bushing.

C. Use slotted bracket to support vacuum control in proper position to allow distributor to rotate freely on vacuum advance.

D. Mount distributor in V-Clamp and lower shaft into chuck. Clamp distributor shaft firmly in chuck and align clamp in center position. Rotate disc by hand until Clamp's properly centered and disc rotates freely.

4-2-2 Review preliminary test instructions.

A. Both speed control and test selector switch must be in off position.

B. Connect tester line cord to AC outlet.

C. Caution: do not operate motor without a distributor mounted in chuck.

D. Mount distributor V-Clamp and secure shaft firmly in chuck jaws.

E. Connect test lead to distributor insulated point terminal and bare Grd. Clip to distributor body at a good clean surface area.

4-2-3 Refer to activity sheets for point resistance test, condenser test, general test information.

4-3-0 The project teacher will demonstrate and provide activities on the use of the Headlight Tester.

4-3-1 Students will study the Four--Headlight System.
4-3-2 Require the students to follow the operating instruction manual for Headlight tester.

4-4-0 The project teacher will give instructions for 90 minutes on the operations and functions of the Alternator - Regulator - Battery - Starter - Tester.

4-4-1 Require the students to study and practice the Battery Capacity test.
4-4-2 Students will study the Starter Draw Test procedures and perform the procedures on the tester.
4-4-3 Have the students to crank engine for 5 seconds while noting starter draw on 500 AMPS scale, and cranking voltage on 20 volts scale.
4-4-4 List safety precautions to follow when using tester.
4-4-5 Measure the amps from several batteries with a load.
4-4-6 Secure 3 alternators and 3 starters and test.

4-5-0 The project teacher will demonstrate the use of the battery charger.

4-5-1 Have the students to learn the proper way of connecting the charger to the battery.
4-5-2 Require the students to learn the function of all control knobs.
4-5-3 Study the slow charging procedures and the fast charging procedures.
4-5-4 The students will study and follow operating Guide Model 32-134 for battery charger to be handed out by teacher.
4-5-5 Unit test.

1-2-5

STUDY QUESTIONS

TOOLS AND THEIR FUNCTION

1. What wrench is used to tighten nuts and bolts to specification?
2. Why should you keep your tools clean?
3. Name two types of screwdrivers.
4. What kind of hammer should the mechanic use?
5. If you had a box-end wrench with 9/16 on one end, what could be the other sizes?
6. List three types of wrenches.
7. Can a ratchet handle be used on the combination open and box-end wrench?
8. What tool is used to measure the engine cylinder?
9. What machine is used to completely analyze the car?
10. Define the following words or terms:
    - A. Primary
    - B. Secondary
    - C. Polarity
    - D. KV
    - E. Ground
    - F. Lobe
    - G. RPM
    - H. Ballast
    - I. Dwell
    - J. TDC
    - K. BDC
11. Explain how to put number one (1) piston on T.D.C.
12. List the procedure used in testing the alternator.

HAND TOOLS

Nuts, Screws, Bolts, and Studs

In the correct column below, list the various types of nuts, screws, bolts, and studs.

Nuts	Screws	Bolts	Studs

2-1-5

HAND TOOLS

Fasteners

Study the various fasteners. In the first column list the name of each one. In the second column list the funtion of each.

Hand Tool	Function

2-1-5a

HAND TOOLS

Lock Washers

Below is a list of the various lock washers. After each, write its function.

1. Plain---

2. External---

3. Internal---

4. External-Internal---

HAND TOOLS

Rivets

In the columns below, list the name of each rivet. In the second column, name the use.

Rivets	Use

HAND TOOLS

Test Equipment

Read the combustion from several engines or cylinders. Record your finding below:

Engine	Readings
1.	
2.	
3.	
4.	
5.	

4-5-5

TEST ON TOOLS AND THEIR FUNCTIONS

1. List five types of wrenches.

A. C. E.

B. D.

2. Name three handles that could be used with a socket wrench.

A. B. C.

3. What tool is used with the socket and ratchet to get to nuts and bolts in close places?

4. What tool is used to measure the cylinder bore?

5. What kind of washer would you use with a nut and bolt to lock the nut?

6. Is it possible to check the alternator with the King electronic tester?

7. What is the dwell meter used for?

8. What is the scientific name for the timing light?

9. Name the instrument you should use in testing a battery?

10. What tools are used to remove a broken head bolt from the engine block?

11. What are feeler gauges?

12. Describe the procedure of measuring a shaft with an outside caliper.

13. Name the important things to do in taking care of tools.

1.

2.

3.

14. What machine is used to reface the valve seat?

15. List the four parts of the machine that answer No. 14.

A. C.

B. D.

UNIT IV

PREVENTIVE MAINTENANCE

1-0-0 At the end of the job, the students will apply their knowledge of draining and refilling the crankcase with a 100% accuracy using the factories standards.

1-1-0 The project teacher will provide activities on draining and refilling the crankcase with oil for 25 minutes as monitored by the project monitoring system.

1-1-1 Warm up engine and then cut off ignition switch.
1-1-2 Raise car and secure on stands or lifts.
1-1-3 Drain crankcase oil in drain pan or can.
1-1-4 Replace drain plug securely and refill crankcase to proper level.
1-1-5 Clean up work station.
1-1-6 Have instructor check completed job.
1-1-7 Answer questions on draining and refilling crankcase (Handout 1-1-7)

1-2-0 The project teacher will provide activities on removing and replacing elements in oil filters for 50 minutes as monitored by a monitoring system.

1-2-1 Place a pan or can under filter and remove drain plug.
1-2-2 Loosen cap screw or cover nut.
1-2-3 Remove cover and gasket.
1-2-4 Remove filter elements and seal (if any)
1-2-5 Wipe the inside of the case clean.
1-2-6 Replace and tighten the drain.
1-2-7 Install the bottom oil seal inside the filter case if used.
1-2-8 Replace filter element by pushing it slowly over the center tube.
1-2-9 Replace top seal if used and cover, using a new gasket. Tighten cap screw securely.
1-2-10 Run engine ten minutes.
1-2-11 Check oil to crankcase.
1-2-12 Add oil to crankcase.
1-2-13 Check flexible oil lines and report their condition to instructor.

1-2-14 Have instructor check complete job. (Handout 1-2-14)

1-3-0 The project teacher will provide activities on lubricating automobiles for 50 minutes, as monitored by the project monitoring system.

1-3-1 Place car in position on lift. Do not raise lift until it is checked by instructor.
1-3-2 Open hood and cover fenders.
1-3-3 Lubricate components under the hood that use motor oil.
1-3-4 Check engine oil.
1-3-5 Clean and oil crankcase ventilator.
1-3-6 Clean and inspect air filter or cleaner.
1-3-7 Lubricate steering gear. For power steering, refer to manual.
1-3-8 Lubricate upper control arms. (Note: some cars have plugs that must be moved.)
1-3-9 Check water level in battery.
1-3-10 Raise car with lift.
1-3-11 Clean fittings and lubricate front-end suspension and steering connections.
1-3-12 Lubricate clutch and brake pedal bushings, lubricate universal joint, check differentials, and refer to manufacturer's manual for proper check of transmission fluid. (Report to instructor)
1-3-13 Let instructor check your completed job.
1-3-14 Lower lift and remove car.
1-3-15 Clean up work station.
1-3-16 Answer questions on lubricating an automobile. (Handout 1-3-16)

1-4-0 The project teacher will provide activities on removing, lubricating, and adjusting front wheel bearing for 50 minutes as monitored by monitoring system.

1-4-1 Look up the different types of wheel bearings.
1-4-2 Jack up car and secure it on stands.
1-4-3 Remove carter pin, adjusting nut, washer and outer bearing.
1-4-4 Remove front hub caps.
1-4-5 Remove wheel by pulling straight out to prevent damage to the grease seal.
1-4-6 Remove the grease seal and inner bearing. Wash all parts thoroughly in cleaning solvent and dry.
1-4-7 Check all bearings for cracked bearing cases, worn, pitted balls or rollers.
1-4-8 Check for cracked or rough inner and outer cups.
1-4-9 Pack wheel bearings with wheel bearing grease.
1-4-10 Have instructor check at this point.
1-4-11 Install inner bearing and grease seal.
1-4-12 Put wheel on spindle and install outer bearing washer and nut.
1-4-13 Adjust the bearings by tightening the adjusting washer.

and nut while rotating the wheel back and forth. (Refer to service manual).

1-4-14 Lock the nut with a new carter pin.
1-4-15 Have instructor check at this point.
1-4-16 Install dust and hub caps.
1-4-17 Clean up work station.
1-4-18 Lower car to floor.
1-4-19 Answer question on removing, lubricating, and adjusting front wheel bearing. (Handout 1-4-19)

1-5-0 The project teacher will provide activities on removing and installing rear wheel bearings and grease seals for 100 minutes as monitored by the project monitoring system.

1-5-1 Jack up car and secure it on stands.
1-5-2 Remove hub cap and rear wheel.
Note: Some time you will find retaining nuts. If so, remove them and then remove the drum.
1-5-3 Use wheel puller to remove drum.
1-5-4 Remove real axle (use shaft puller)
1-5-5 Remove grease seal (use special tool)
1-5-6 Check bearing on axle shaft for looseness. If excessive looseness is found the bearing has to be replaced.
1-5-7 If the bearing needs replacing, nick the lock ring with a chisel and remove the bearing with a special puller.
1-5-8 Soak oil seal in light engine oil for at least one half hour and then install oil seal in the base of axle housing with lip facing in.
1-5-9 Install bearing and new lock ring on axle shaft and press on.
1-5-10 Have instructor check your work at this point.
1-5-11 Install axle shaft in housing.
1-5-12 Install brake drums and wheel.
1-5-13 Lower car to floor.
1-5-14 Clean up station.
1-5-15 Have instructor check completed job.
1-5-16 Remove rear wheel hub caps.
1-5-17 Remove carter pin from the axle shaft.
1-5-18 Loosen the axle nut.
1-5-19 Loosen the nuts or bolts.
1-5-20 Jack up the rear wheels and secure on stands.
1-5-21 Remove the lug bolts or nuts and wheel.
1-5-22 Remove the axle nuts and washer.
1-5-23 Install a wheel puller and pull the wheel off rear brake drum. (If you have a loose brake shoe check with your instructor)
1-5-24 Disconnect the brake line, remove the axle drive key.
1-5-25 Remove the bolts attaching the brake backing place to the axle housing and remove the backing plate.
1-5-26 Remove the shims from the axle housing and keep together for reassembling.
1-5-27 Remove the axle shaft and bearing with a special puller.

1-5-28 If the axle shaft bearings are worn or damaged, replace them.
1-5-29 Remove the outer seal from the brake backing plate.
1-5-30 Have instructor to check at this point.
1-5-31 Clean all parts and dry them.
1-5-32 Soak oil seal in oil.
1-5-33 Pack rear axle bearing with grease (wheel bearing grease)
1-5-34 Install the axle shaft and bearing in axle housing.
1-5-35 Install the axle bearing outer cup.
1-5-36 Replace axle housing shims in the same position as they were removed.
1-5-37 Install a new outer seal in the backing place and install backing plate.
1-5-38 Install the bolts attaching the brake backing plate to axle housing and tighten bolts to specification.
1-5-39 Install the axle drive key and the brake drum.
1-5-40 Check axle shaft and play and check specification if not within manual for adjustment.
1-5-41 Connect the brake line.
1-5-42 Install the axle drive key and the brake drum.
1-5-43 Install the axle nut and washer, tighten snug.
1-5-44 Place the wheel in place and install lug nut or bolts.
1-5-45 Lower car and tighten lug bolts and axle and axle nut to specification.
1-5-46 Install cotter pin in axle and replace hub cap.
1-5-47 Have instructor check completed job.
1-5-48 Clean up work area.
1-5-49 Answer questions on removing and installing rear wheel bearings and grease seals. (Handout 1-5-49)

1-6-0 The project teacher will provide activities on adding brake fluid to a cylinder for 50 minutes as monitored by the project monitoring system.

1-6-1 Carefully clean all dirt and grit from the top of master cylinder.
1-6-2 Use correct wrench size (Never pliers) to remove reservoir cap.
1-6-3 Examine cap to make certain that baffle is in place and vent hole is not clogged. Blow vent hole out with air nozzle.
1-6-4 Fill reservoir until fluid is approximately ½ inch below top of master cylinder. Do not over fill.
1-6-5 Replace cap making certain gasket is in place.

1-7-0 The project teacher will provide activities on installing sealed beam and aim headlights for 50 minutes as monitored by the project montoring system.

1-7-1 Remove headlamp door rim. Remove the retaining spring from the retainer ring on the light you are going to replace.
1-7-2 Remove the head light retaining ring screws. Do not disturb the adjusting screws.
1-7-3 Remove the retaining ring and pull the light forward and disconnect the connector ring.
1-7-4 Install new sealed beam and connect it.

1-7-5 Install retaining ring.
1-7-6 Have instructor check job.
1-7-7 Use headlight aimer and adjust to specifications following equipment manufacturer's instruction.
1-7-8 If aimer is not available, place car 25 feet from aiming screen on a level and align center line of screen to center of car.
1-7-9 Adjust the head vertical aim of each of the single filament lights to manufacturer's specifications as outlined in shop manuals.
1-7-10 Adjust the head light horizontal aim of the single filament lights.
1-7-11 Switch the lights on the low beam and adjust the two filament lights to car manufacturer's specifications.
1-7-12 Have instructor check job.
1-7-13 Install the headlight door rim.
1-7-14 Clean up work area.
1-7-15 Answer questions on installing Sealed Beam and Aim Headlights (Handout 1-7-15)

1-8-0 The project teacher will provide activities on installing mufflers and tail pipes for 50 minutes as monitored by the project monitoring system.

1-8-1 Loosen the clamp at front of muffler.
1-8-2 Loosen the clamp at the rear of muffler.
1-8-3 Take tail pipe loose at front and rear tail pipe brackets.
1-8-4 Remove tail pipe from muffler.
1-8-5 Remove muffler from pipe.
1-8-6 Check and tighten muffler inlet pipe.
1-8-7 Install muffler assembly on inlet pipe (do not tighten).
1-8-8 Install muffler outlet pipe and install front and rear brackets (do not tighten).
1-8-9 Line up tail pipe.
1-8-10 Tighten rear tail pipe clamp and clamp bracket.
1-8-11 Line up all joints by shaking muffler.
1-8-12 Tighten front tail pipe bracket and clamp in this position.
1-8-13 Tighten front and rear muffler clamps.
1-8-14 Clean up station.
1-8-15 Have instructor check your job.
1-8-16 Answer questions on muffler and tail pipe (Handout 1-8-16)

1-9-0 The project teacher will provide activities on balancing wheels on the car for 50 minutes, as monitored by the project monitoring system.

1-9-1 Clean wheels.
1-9-2 Install Model 127 wheel adaptor.
1-9-3 Remove hub cap and chrome ring if necessary.
1-9-4 Select proper adaptor according to wheel size.
1-9-5 Check adaptor to make sure both cam-lever arms are in unlocked position (indicated by red flags when viewing adaptor from front).
1-9-6 Adjust both diameter adjustment screws if necessary, so that the neoprene ring is just barely snug in wheel rim. (do not turn adjustment screws too tightly.)

1-9-7 Swing the two cam-level arms into locked position, both at the same time, so that the red flags are not visible.
1-9-8 Install 107-A Instrument on adaptor.
1-9-9 Mount 107-A Instrument over adaptor by lining up 4 holes in lock with 4 adaptor studs.
1-9-10 Gently press on instrument near lock before closing lock, and close 4 locks. (Don't force locks)
1-9-11 Before spinning:
  (a) Remove rocks and gravel from tire tread.
  (b) Check for dragging brakes and tight wheel bearings.
  (c) Make sure both adaptor cam-level arms are in locked position.
  (d) Make sure all 4 catches on instrument are closed.
  (e) Pull firmly on adaptor to make sure it is properly installed on wheel.
1-9-12 Spin the wheel while no one is in line with it.
1-9-13 Put your instrument back in spinner case (top side up).

1-10-0 The project teacher will provide activities on tune-in for 50 minutes as monitored by the project monitoring system.

1-10-1 Jack up front of car at center, both front wheels about 1½" above floor.
1-10-2 Move your wheel balancing machine to job on car.
1-10-3 Spin wheel (using foot pedal) to check for out of balance.
1-10-4 Install adaptor and tune in to wheel correclty (read instructions carefully).
1-10-5 At this point, the instructor will demonstrate and explain the use of the knobs while tuning in.
1-10-6 The students will clean up the work station.
1-10-7 Answer questions on balancing wheels. (Handout 1-10-7)

1-11-0 The project teacher will provide activities on making minor brake adjustments for 50 minutes as monitored by the project monitoring system.

1-11-1 Obtain manufacturer's repair manual. Check for brake pedal free play. If necessary, adjust to approximately ½ inch.
1-11-2 Check brake fluid. Add if necessary.
1-11-3 Raise car and put shop safety stands in place. Lower car on stands, making certain that stands are placed solidly under frame or axle.
1-11-4 Remove the cover from the adjusting hole and, turning the adjusting wheel to expand the shoes until they drag against the drum.
1-11-5 Continue to tighten adjuster until the wheel can not be turned by hand.
1-11-6 After correct drag is obtained, back off on the adjuster. Screw 12 notches (these specifictions may vary from one vehicle to another). The wheel should now turn free.
1-11-7 Replace adjuster hole cover and proceed to other wheels.
1-11-8 Answer question on minor brake adjustments (Handout 1-11-8)

1-12-0 The project teacher will provide activities on making minor brake adjustments, (lockheed), for 50 minutes as monitored by the project monitoring system.

1-12-1 Obtain manufacturer's repair manual. Check pedal free play. Adjust if necessary.
1-12-2 Check brake fluid. Add if necessary.
1-12-3 Raise car and correctly place safety stands before starting.
1-12-4 Make adjustments on lockheed brakes. Adjust them by the movement of cams. The cam is moved by turning the spring-loaded bolt on the rear of the backing plate. There are two cams to each wheel.
1-12-5 Make adjustment on front wheel. Turn the cam in the direction of forward wheel rotation to lcok wheel. Turn the cam in the other direction until no drag is felt. Repeat the same operation on the other cam.
1-12-6 Make adjustments on the rear wheel brakes. Turn the cam on the forward brake shoe in the direction of forward wheel rotation to lock shoe to drum. Turn against wheel rotation to get shoe to drum clearance. Reverse procedure to adjust the rear shoes.

1-13-0 The project teacher will provide activities on adjusting parking brakes (external contraction).

1-13-1 Obtain manufacturer's manual, if available.
1-13-2 Jack car and place on four shop safety stands.
1-13-3 Place parking brakes control lever in full release position.
1-13-4 Use manufacturer's manual to determine specific adjustments.
1-13-5 After making adjustments, check if the wheels turn only when operating lever is in the released position.

1-14-0 The project teacher will provide activities on adjusting parking brakes (internal type) for 25 minutes as monitored by the project monitoring system.

1-14-1 Obtain manufacturer's manual for unit to be worked on.
1-14-2 Jack car up in rear. Place safety stands under axle of frame and make sure that parking brake lever is in full released position.
1-14-3 Locate adjuster.
1-14-4 Loosen lock nut and adjust until absolutely no drag is felt when turning rear wheels.

1-15-0 The project teacher will provide activities on inspection of brake linings and drums for 50 minutes as monitored by the project monitoring system.

1-15-1 Jack up vehicle and place on stands solidly under frame. Remove all wheels and brake drums. Many times, if drums are worn, it will be necessary to back off on the brake adjuster in order to clear the rim of the drum.

1-15-2 Inspect brake lining for wear or cracks. If lining is cracked or worn ½ its original thickness (bonded), it should be replaced. Any riveted type brake lining should be replaced before it wears down to the rivet heads.

1-15-3 Inspect shoes for foreign materials, such as grease, brake fluid, oil, etc. If shoes are oil or fluid soaked, they should be replaced.

1-15-4 Inspect brake drums for scoring and grooving. Reconditioning of the drum or replacement is justified only if scoring or grooving is excessive.

1-15-5 Inspect front and rear wheels for oil or grease seal leakage.

1-15-6 Check star wheel adjuster (if equipped) for binding or stripped notches.

1-15-7 Inspect wheel cylinders for leakage by sliding wheel cylinder boots back and observing end of cylinder.

1-15-8 Check all bearing and pivot points for lubrication.

1-15-9 Blow dust from drum and brakes with air hose, if no repairs are to be made.

1-15-10 Replace wheels and drums. Make minor adjustments and have instructor inspect completed job.

1-15-11 Clean up work station.

1-16-0 The project teacher will provide activities on inspection of steel tubing and flexible brake lines for two class periods, as monitored by the project monitoring system.

1-16-1 Check fluid level in master cylinder. Observe area around fittings for dampness or signs of leakage.

1-16-2 Slide boot back from rear of master cylinder and check for fluid leakage.

1-16-3 Locate and check all brake line connections for leaks.

1-16-4 Check all tubing that may come in contact with the frame. Check these points for rubbing which may weaken tubing.

1-16-5 Check flexible brake lines for signs of rot, cracked covering, twisting, or leakage.

1-16-6 Check for leakage around bleeder cocks.

1-16-7 Report all defects or faults found in tubings or flexible lines to your instructor.

1-16-8 Clean up work station.

1-16-9 Answer questions on inspection of linings and drums (Handout 1-16-9)

1-16-10 Evaluation (Handout 1-16-10)

STUDY QUESTIONS

DRAINING CRANKCASE AND REFILLING

1. Why should old oil be allowed to drain for a time?
2. What precautions must be followed in draining oil from the crankcase?
3. What methods are used to keep the oil in the crankcase free from dirt and grit?
4. What are some reasons that cause engine oil to be low?
5. What is sludge?
6. Define:

    (a) dilute

    (b) By-pass

    (c) corrode

    (d) crankcase

1-2-14

STUDY QUESTIONS

ENGINE LUBRICATION

1. Name three ways oil can be lost from the engine.
2. Name and explain the three types of lubrication systems.
3. Name the two types of oil filters used.
4. What are the two most commonly used oil pumps?
5. Explain how the by-pass filter operates.
6. Explain how the full-flow filter operates.
7. What is used in the full-flow filter to secure lubrication even if the filter becomes clogged?
8. What purpose does the gasket serve?
9. What is viscosity?
10. How do you repair a stripped oil drain plug?
11. Into what two properties can a viscosity be divided?
12. Why are body and fluidity important in an oil?
13. What effect does temperature have on viscosity?
14. Why is the crankcase ventilated?
15. Where can information be obtained with reference to the frequency of oil changes and the type of oil to be used?
16. How does oil reduce friction?
17. How does water sludge form?
18. What are the three service ratings of oil for gasoline engines?
19. What would SAE 10W-30 mean?
20. If an oil has this marking on the can, SAE 20W, what would it mean?
21. What is an oil gallery?

1-3-16

STUDY QUESTIONS

LUBRICATION OF THE AUTOMOBILE

1. What precaution should be taken when lubricating an automobile?

2. What part of the automobile should be lubricated first?

3. Name two parts that you would use motor oil to lubricate.

4. How would you clean the oil crankcase ventilator?

5. What purpose does a lubricant serve?

6. Why is it necessary to clean and oil the crankcase ventilator inlet and outlet air cleaners?

7. What procedure should be used in checking fluid in an automobile transmission?

8. What types of oil are used in standard transmission?

9. Is it necessary to check the water in the battery when lubricating an automobile?

10. How do you check the differential?

STUDY QUESTIONS

REMOVE, LUBRICATE, AND ADJUST FRONT WHEEL BEARING

1. When should all parts be washed and dried?
2. Is wheel bearing grease the same as other lubricants used in the automobile?
3. Why is the wheel rotated while adjusting the bearings?
4. What precautions should be taken in removing, lubricating, and adjusting front wheel bearing?
5. A good engine oil has a task, what is it?
6. What is meant by the term friction?
7. What is a frozen bearing?

STUDY QUESTIONS

REMOVE AND INSTALL REAR WHEEL BEARINGS AND GREASE SEALS

1. How is the axle shaft held in the axle housing?

2. Does the axle shaft bearing need packing before installing?

3. What kind of defects do you look for to justify wheel or axle bearing replacements?

4. Is it necessary to bleed the brakes after replacing bearings? Why?

5. What tool is used to pull off rear brake drum?

6. What should be done to leather seals before installing them?

STUDY QUESTIONS

SEALED BEAM AND AIMED HEADLIGHTS

1. How many light filaments does a sealed beam have?
2. What effect will a broken ground wire have on a sealed beam light?
3. Why should the #2 lights be set on the low beam?
4. Why should all lights except the light being adjusted be covered?
5. What is provided in each sealed beam frame so the light may be aimed?
6. What takes up the slack when the adjustment is loosened?
7. How far should a sealed beam drop in 25 feet?
8. How far should the sealed beam be from the aiming screen?
9. What is a headlight retaining ring?
10. What is a light filament?

STUDY QUESTIONS

MUFFLERS AND TAILPIPES

1. How can one identify the front from the rear of a muffler?
2. How can one tell the top from the bottom of a muffler?
3. Name two types of mufflers.
4. What is the purpose of a muffler?
5. Could a non-regulation muffler lead to engine overheating?
6. How can a tail pipe being burned out in front of the gas tank cause poor gas mileage?
7. What procedure should be used in lining up a muffler and tail pipe?
8. What is the purpose of the resonator?

STUDY QUESTIONS

BALANCING WHEELS

1. On which side of the wheel should balancing weights be placed?
2. Which should be done first dynamic or static balancing?
3. What is meant by the term static balance?
4. What is meant by the term dynamic balance?
5. Where should the weights be applied on the wheel?

STUDY QUESTIONS

MAKING MINOR BRAKE ADJUSTMENTS

1. Explain how to check for brake pedal free play.
2. If brake pedal has to much free play it should be adjusted to approximately ______________________ inch.
3. Explain how to adjust brakes according to the specification used in minor brake adjustments.
4. What is a spring loaded bolt?
5. Self-adjusting brakes will make adjustments when moving backward or when moving forward?
6. Name three definite characteristics brake fluid must have.

STUDY QUESTIONS

INSPECTION OF LININGS AND DRUMS

1. Is it necessary to remove the wheel to inspect the drum?

2. What is a drum?

3. Name two things that you can inspect your brake drum for.

4. What are wheel cylinders used for?

5. Brake lines must be made of ____________________.

6. What unit is used to keep brake shoes in close contact with the drum?

1-16-10

TEST

PREVENTIVE MAINTENANCE

1. Why should old oil be allowed to drain for a period of time?

2. List three precautions to follow in changing engine oil.

3. What methods should be used to keep the crankcase oil free from dirt and grit?

4. Does an engine crankcase have ventilators? If yes, what type?

5. Define the following:

   (a) by-pass

   (b) viscosity

   (c) sludge

   (d) full-flow

   (e) dilute

   (f) corrode

6. In what three ways is oil lost from an engine?

7. Name three types of lubricating systems.

8. Name two types of oil filters.

9. Is it necessary to lubricate the rear spring shackles on a car? Why?

10. Why should you never over-lubricate a generator?

11. What procedure should be used in checking transmission fluid in automobile transmissions?

12. Does the engine need to be running to check power steering?

13. What type of oil does a standard transmission use?

14. Are there any differences in wheel bearing grease and other lubricants used in the automobile?

15. Why rotate the wheel while adjusting the bearing?

16. What precautions should be taken when you remove, lubricate, and adjust front wheel bearings?

17. Why should grease be kept away from the brake lining?

18. What type of lubricant should be used on front and rear wheel bearings?

19. What is the difference between seals, packing, and gaskets?

20. How is the axle shaft held in the axle housing?

21. After replacing rear wheel bearings, is it necessary to bleed the brakes?

22. What defects do you look for to justify wheel or axle bearing replacements?

23. What is a master cylinder?

24. What happens when a small amount of air enters the brake system?

25. Explain how power brakes work.

26. If brake shoes are oiled or fluid soaked, what should be done?

27. Define fuse.

28. What is a filament?

29. How many filaments are there in a tail-light bulb?

30. How is the sealed beam unit held in place in the headlight?

31. How far should a sealed beam drop in twenty-five feet?

32. What is the function of a muffler?

33. Name two muffler designs.

34. Explain how burned gases leave the engine.

35. What four components make up the exhaust manifold?

36. Explain the function of the exhaust manifold.

37. What is the function of the resonator?

38. What purpose does the exhaust pipe serve? Tail pipe?

39. What is engine exhaust?

40. Define:

    (a) fuel
    (b) high oil consumption
    (c) manifold
    (d) manifold heat control valve

85/86/87/88

UNIT V

ELECTRICAL SYSTEM

1-0-0 At the end of the job, the students will apply their knowledge of a multi cell battery by scoring 70% or above on a teacher prepared test.

1-1-0 During one class the power mechanics instructor will demonstrate correct procedure in care and maintenance of a battery as monitored

1-1-1 Discuss the uses of an automobile battery.
1-1-2 Demonstrate how a multi cell battery operates.
1-1-3 Demonstrate the construction of a battery.
1-1-4 Demonstrate how the battery cells are opened.
1-1-5 Discuss the method of rating batteries.
1-1-6 Stress the danger of sulfuric acid. Explain how the acid is used for an electrolyte.
1-1-7 Discuss the way a battery develops electricity.
1-1-8 Handout

1-2-0 Power mechanics instructor during one class will demonstrate proper procedure in measuring specific gravity of battery acid as monitored by the project monitoring system.

1-2-1 Demonstrate removal of caps consealing cells.
1-2-2 Write down specific gravity of the battery.
1-2-3 Demonstrate correct method of checking battery for cracks.
1-2-4 Demonstrate the cleaning of the anode and cathode.
1-2-5 Demonstrate proper water level of each cell.
1-2-6 Demonstrate replacement of caps securely.
1-2-7 Discuss the dangers of tilting a battery.
1-2-8 Demonstrate placing hydrometer to measure specific gravity.

2-0-0 At the end of the job, the students will apply their knowledge of the operation of a bolt meter by scoring 70% or above on a teacher-made test.

2-1-0 The power mechanics instructor during one class will show the students correct procedures in using a volt meter as monitored by the project monitoring system.

2-1-1 Demonstrate correct location of probs.
2-1-2 Discuss the uses of a volt meter.
2-1-3 Demonstrate the method of reading a volt meter.
2-1-4 Discuss the measuring of volts.
2-1-5 Discuss relationship of voltage to current.
2-1-6 Discuss relationship of voltage to resistance.
2-1-7 Discuss the meaning of A. C. current.
2-1-8 Discuss the meaning of D. C. current.
2-1-9 Discuss the reason for always placing a volt meter in parallel with a circuit.

3-0-0 At the end of the job, the students will apply their knowledge of mechanical fundamentals by scoring 70% or above on a teacher-made test.

3-1-0 Power mechanics instructor during three classes will demonstrate correct procedure in assembly and disassembly of an automobile A.C. and D.C. generator as monitored by project monitoring system.

3-1-1 Discuss uses of a generator.
3-1-2 Discuss what a generator does.
3-1-3 Discuss the principles of D.C. generator.
3-1-4 Demonstrate the construction of a generator.
3-1-5 Discuss the principles of A.C. generator.
3-1-6 Demonstrate alternator construction.
3-1-7 Discuss the regulators of both A.C. and D.C. generators.

3-2-0 Power mechanics instructor during two classes will demonstrate correct procedure in maintenance and repair of an automobile starter or cranking motor as monitored by the project monitoring system.

3-2-1 Discuss electric motor principles.
3-2-2 Demonstrate construction by disassembling a starter.
3-2-3 Demonstrate inertia drive.
3-2-4 Demonstrate the overrunning clutch.
3-2-5 Discuss and demonstrate cranking motor control.

3-3-0 Power mechanics instructor during two classes will demonstrate correct procedure in maintenance and repair of an automobile solenoid as monitored by the project monitoring system.

3-3-1 Discuss the basic concepts of the solenoid.
3-3-2 Discuss how the solenoid works along with the starter.
3-3-3 Discuss and demonstrate how electricity effects the solenoid sucking action.

3-4-0 Power mechanics instructor during two classes will demonstrate correct method of repair and operation of a voltage regulator as monitored by the project monitoring system.

3-4-1 Discuss regulators for D.C. generators.
3-4-2 Discuss and demonstrate temperature compensation of a voltage regulator.
3-4-3 Describe and discuss the following:
    (a) Voltage regulator
    (b) Voltage regulator with field relay
    (c) Transistorized voltage regulator with field relay
    (d) Integral voltage regulator

3-5-0 Power mechanics instructor during one class will instruct student in theory and operation of an ammeter gauge as monitored by the project monitoring system.

3-5-1 Demonstrate the use of ammeter.
3-5-2 Demonstrate where ammeter should be connected in the circuit.
3-5-3 Explain the reasons for having an ammeter.
3-5-4 Discuss the job the ammeter performs.
3-5-5 Demonstrate the reason an ammeter works.

3-6-0 Power mechanics instructor during one class will instruct the student in the operation of the distributor as monitored by the project monitoring system.

3-6-1 Discuss the operation of the distributor.
3-6-2 Discuss what happens when the points are open.
3-6-3 Describe the different types of distributors:
  (a) Distributor with contact point
  (b) Distributor with magnetic pickup
  (c) Distributor with contact point and transistorized system
3-6-4 During one class period have the student draw a diagram of the distributor system.

3-7-0 Power mechanics instructor during two classes will instruct the student in the design and operation of spark plugs as monitored by the project monitoring system.

3-7-1 Discuss the basic parts of a spark plug:
  (a) Metal shell
  (b) Ground electrode
  (c) Terminal
  (d) Resistor
  (e) Shell
  (f) Porcelain insulator
  (g) Electrode extending through the insulator.
3-7-2 Describe location of spark plug in an automobile.
3-7-3 Explain the reason a spark plug does not interfere with your radio.
3-7-4 Demonstrate the spark produced by the spark plug.

3-8-0 The power mechanics instructor in two days will instruct the students in the theory and operation of a coil as monitored by the project monitoring system.

3-8-1 Discuss the purpose of the coil.
3-8-2 Describe different types of coils.
3-8-3 Discuss the operation of a coil.
3-8-4 Demonstrate a magnetic field of a coil.
3-8-5 Discuss voltage produced by coils.
3-8-6 Demonstrate the flow of electricity from battery through the coil.
3-8-7 Answer study questions (handout).

3-9-0 Power mechanics students during two classes will be introduced to the theory and application of a horn relay in an automobile as monitored by the project monitoring system.

3-9-1 Discuss the purpose of the horn relay coil.
3-9-2 Demonstrate the way the relay makes a horn blow.
3-9-3 Demonstrate a relay in a new car by opening the door with key in the ignition.

4-0-0 Administer Unit Test covering Interims 1-4

INFORMATION SHEET *

Electrical Safety

When installing electrical components, make certain they are properly fused. Wires must be insulated, kept from hot areas, and must be secured to prevent chafing. When passing through metal parts, install grommets, (rubber insulating washers), to protect the wires. Terminals should be clean and tight.

When working on the electrical system, disconnect the battery to prevent accidental short circuiting.

Use great care when repairing head lamp circuits. If the lights suddenly go out, it could be tragic.

Never replace a fuse with a fuse of higher capacity. Never replace a fuse with a bolt, wire, etc. The fuse, of correct capacity, must be in the circuit.

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[*] Stockel, Martin W. Auto Mechanics Fundamentals. Homewood, Illinois: Goodheart-Wilcox Company, Inc., 1969, page 402.

1-1-8a

ELECTRICAL SYSTEM

Define the following:

1. Electron Theory
2. Matter
3. Molecule
4. Atoms
5. Current
6. Voltage - EMF
7. Resistance
8. Conductors
9. Circuit
10. Series circuit
11. Parallel circuit
12. Insulators
13. Series parallel
14. Ohms Law
15. Magnetism
16. Tires of force
17. Unlike and like charges
18. Battery
19. Generator
20. H_2SO_4
21. Electromagnetic
22. Alternating current

23. Direct current
24. Armature
25. Commutator
26. Brushes
27. Voltage regulator
28. Ammeter
29. Starter
30. Flywheel ring gear
31. Solenoid
32. Horn
33. Relay
34. Fuse
35. Dimmer switch
36. Bulbs
37. Seal beam
38. Gauges

ELECTRICAL SYSTEM

3-8-7 Study Questions

1. Current flows from negative to positive. True or False
2. What do you use to charge a battery? ____________________
3. What method is used to check battery polarity? ____________________
4. What are the major differences between DC Generator and AC Alternator?
5. What is the purpose of a generator?
6. What does an ammeter measure?
7. Describe the method of checking battery electrolyte with a hydrometer.
8. Define the following:

   polarity

   ampere

   resistance

   direct current

   alternating current

   Ohms Law

   battery

   current

   H_2SO_4

   voltage

POWER MECHANICS

4-0-0 Electricity Test

1. What is the symbol for the ground of an automobile battery?
2. What is a storage battery used for in an automobile?
3. What are the three common methods of rating batteries?
4. Name four parts of a common storage battery.
5. What is a good specific gravity of battery electrolyte?
6. What does a voltmeter measure?
7. Where are the probs connected to check voltage?
8. Explain the relationship voltage have to current.
9. Define alternating current.
10. Define direct current.
11. Explain the major difference between AC and DC generators.
12. What would happen if the generator was not controlled as the speed increased?
13. Why does the AC generator require diodes?
14. Name three parts of a DC generator and three parts of a AC generator.
15. Why is the name alternator given to an AC generator?
16. What is the purpose of a starter?
17. What happens to the drive pinion of the starter after the engine starts?
18. Describe briefly the operation of the solenoid in the cranking of an engine.
19. Name several parts of the cranking motor.

20. Describe the sucking action of the solenoid.

21. Explain the operation of a AC voltage regulator.

22. Describe how the transistorized voltage regulator works.

23. What does an automobile ammeter measure?

24. Briefly explain the operation of an ammeter.

25. List three types of distributors.

26. What job does the distributor have?

27. What happens when the circuit is open at the points?

28. List three parts of a spark plug.

29. What is the spark plug used for in an automobile engine?

30. What part of the spark plug helps reduce the radio interference?

31. Explain the purpose of a relay.

32. How many types of relays are there?

UNIT VI

FUEL SYSTEM

1-0-0 At the end of the job students will apply their knowledge of the fuel system by scoring 70% on a teacher-made test.

1-1-0 The project teacher will provide activities related to removing, installing, cleaning, and replacing the parts of a fuel system for 600 minutes as monitored by a monitoring system.

1-1-1 The teacher will demonstrate the danger of gasoline by starting a gasoline fire under a controlled situation explaining the chemical changes that take place.

1-1-2 Jack up car and remove gasoline tank, and relate to the students how the tank is constructed, and danger of an empty tank.

1-1-3 Remove pickup pipe and explain and demonstrate how it is used to draw gasoline from the tank to the carburetor.

1-1-4 Place water in a glass that contains gasoline to demonstrate the danger of moisture in the fuel system.

1-1-5 Remove the gasoline gauge from the instrument panel and show how it relates to the float in the gasoline tank.

1-1-6 Remove the fuel pump and demonstrate how it operates.

1-1-7 Employing the use of a pressure gauge show students how to measure the pressure exerted by a fuel pump.

1-1-8 Remove fuel filter and explain how it is constructed.

1-1-9 Demonstrate the vacuum system and the relationship between it and the full system.

1-1-10 Activate the throttle control linkage and have students observe the relationship between the throttle system and the choke.

1-1-11 Remove carburetor and have students take it apart under the supervision of instructor.

1-1-12 Demonstrate how a carburetor is cleaned.

1-1-13 Instructor should demonstrate to students the different types of carburetors that are available.

1-1-14 Have students to replace all parts of a carburetor allowing for mistakes.

1-1-15 Assist students as they re-assemble the entire fuel system.

1-1-16 Start engine and observe all parts of the fuel system, while engine is in operation.

1-1-17 Answer question on the fuel system. (Handout 1-1-17)

1-1-18 Evaluate (Handout 1-1-18)

STUDY QUESTIONS

FUEL SYSTEM

1. What components make up a fuel system?
2. Explain the function of a fuel pump.
3. Explain the function of a carburetor.
4. What is the purpose of an air filter or air cleaner for a carburetor?
5. What are fuel gauges used for?
6. Name two types of fuel gauges.
7. What is meant by idle speed?
8. What system is needed to gain a very rich mixture to the intake manifold?
9. Define vacuum.
10. Define the following:
    - (a) supercharge
    - (b) fuel injection
    - (c) anti-icing
11. Name the three basic types of air cleaners.
12. How often should air filters be serviced?
13. What are carburetor jets?
14. What is carburetor linkage?
15. What is vapor lock?
16. Explain the operation of an automobile choke.
17. How is fuel level controlled in the carburetor?
18. What is a dual or two-barrel carburetor?
19. Are there any carburetors with more than two barrels?

UNIT IV

FUEL SYSTEM TEST

1. Define gasoline?
2. What is used to keep fuel clean?
3. Name the components that make up an automobile fuel system.
4. Can gasoline burn alone?
5. Explain the construction of a gas tank.
6. What is a vacuum?
7. Why is it necessary to have a vent pipe on an auto fuel tank?
8. Explain the function of the fuel pump.
9. List the two strokes of the fuel pump and explain each?
10. What is the function of the diaphram in a fuel system?
11. What is the function of the carburetor?
12. List three types of carburetors.
13. Which of the three types of carburetors use the most gas?
14. Explain the purpose of a choke valve?
15. Underline the correct word in the following statements:
    1. On the vacuum stroke the inlet valve is (open/closed)
    2. On the vacuum stroke the outlet valve is (open/closed)
    3. On the pressure stroke the inlet valve is (open/closed)
    4. On the pressure stroke the outlet valve is (open/closed)

UNIT VII

EXHAUST SYSTEM

1-0-0 At the end of the job students will demonstrate their knowledge of the exhaust system by scoring 70% on a teacher-made test.

1-1-0 For 300 minutes, the instructor will provide activities related to removing, replacing, and examining the parts of the exhaust system as monitored by the project monitoring system.

1-1-1 The instructor will point out to students the different parts of exhaust system, explaining the function of each part. Use charts and slides.
1-1-2 Students will examine the different type mufflers. The baffled chambers type and the glass pack or the steel pack.
1-1-3 The instructor will place on display the two types of air cleaners and explain how each operates.
  (a) oil bath air cleaner
  (b) dry type air cleaner
1-1-4 Students will remove the exhaust manifold and examine the exhaust valves.
1-1-5 The instructor examines the manifold and points out to students just how it operates in relation to the exhaust pipes and crossover pipe.
1-1-6 Resonators are removed and examined by students and instructor.
1-1-7 The entire exhaust system is re-assembled and the engine is started to demonstrate to students how to check for leaks and the extent to which the system baffles sound and eliminates gases.
1-1-8 Answer questions on the exhaust system. (Handout 1-1-8)
1-1-9 Evaluate (Handout 1-1-9)

STUDY QUESTIONS

EXHAUST SYSTEM

1. What four components make up the exhaust system?
2. What purpose does the muffler serve?
3. What are the two muffler designs?
4. Explain how burned gases leave the engine.
5. How can you tell one end of the muffler from the other?
6. Why should the exhaust manifolds be smooth inside?
7. What is the main function of the tail pipe in an engine exhaust system?
8. Describe the function of the resonator.
9. What is the function of the exhaust manifold?
10. What is the function of the heat control valve?

UNIT VII

EXHAUST SYSTEM TEST

1. What purpose does the muffler serve?
2. What are the two muffler designs?
3. What four components make the exhaust system?
4. How can you tell the front of a muffler from the back?
5. What is the function of the heat control valve?
6. Exhaust are carried from the exhaust manifold to the muffler by the?
7. What purpose does the resonator serve?
8. What part carries the exhaust gases to the outside air?
9. What is one good reason for keeping the exhaust system in top shape?
10. When will the manifold heat control valve allow exhaust gases to go directly to the exhaust pipe?

UNIT VIII

Tune-Up Procedures

(8 class periods)

1-0-0 At the end of the job the students will apply their knowledge of the fundamentals of tuning an engine by scoring 70% on a teacher-made test.

1-1-0 The project teacher will demonstrate in four class periods procedures in engine tuning as monitored by the project monitoring system.

1-1-1 The students will study the need of engine tune-up.
1-1-2 Require the students to follow the tune-up procedures as listed.

(a) Loosen spark plugs, start engine to blow out dirt and carbon, shut off engine, and remove plugs.
(b) Test engine compression.
(c) If compressions varies more than 20 lbs., perform engine service that will eliminate the trouble. If compression is all right, reinstall the spark plugs.

NOTE: Before reinstalling the plugs, clean, check, and adjust them.

(d) Remove distribution cap, clean it, and visually check it for carbon tracks, burns, chips, or corroded terminals. Discard it if it is not in good condition.
(e) Clean and inspect rotor, and discard it if it is not in good condition.
(f) The students will remove the distributor contact points and clean or replace them as necessary. Readjust point opening. (See specifications for model)
(g) Reinstall distributor cap and replace wires to proper spark plug.
(h) The students will check and adjust contact points dwell and ignition timing.
(i) The students will start the engine.
(j) Adjust idle speed and mixture to specifications.

1-2-0 The project teacher will provide activities for 400 minutes on the steps involved in engine tune-up as monitored by an operational data chart.

1-2-1 The student will check battery state of charge, adding water if necessary, and check battery top. Check condition of battery hold down clamps, tighten them if necessary.
1-2-2 Check battery cables for damage, corrosion, and loose connections and make necessary corrections.

1-2-3 Tighten drive belts (replace the belts if necessary).

1-2-4 Tighten the intake manifold bolts to proper specifications. Even a slight leak will reduce engine performance.

1-2-5 Check fuel lines for tight connections and for kinks and leaks.

1-2-6 Have the students to test the vacuum advance by turning the movable breaker plate and noting whether or not the vacuum - advance spring returns to its original position.

1-2-7 Check for cylinder balance to determine if a cylinder is weak or missing.

1-2-8 The students will check alternator regular settings, voltage drop in charging circuit.

1-2-9 Check ignition timing and adjust if necessary.

1-2-10 Check and adjust the accelerator linkage if necessary.

1-2-11 The students will remove carburetor air cleaner, and check choke valve to make sure the choke is working normally.

1-2-12 Connect vacuum gauge, contact-point dwell meter tachometer, timing light, ignition-system oscilloscope tester and exhaust analyzers.

1-2-13 Start engine and make final adjustment of components.

1-2-14 Students will read and follow the king ignition analyzer instruction manual.

1-2-15 Answer questions on engine tune-up.

ENGINE TUNE-UP GENERAL INFORMATION

The modern high-compression engine is more sensitive to variations from specifications than the earlier slow-speed, lower output engines. To maintain an engine at peak performance and economy, it must be kept in good condition, with all components up to specification. Often during an engine tune-up, conditions will be located which must be corrected in order for the engine to run like new.

There are two general kinds of checks, the visual and mechanical and those made with instruments. Some of the modern diagnostic intruments used in engine checking are quite elaborate and will quickly check the entire engine system. Tune-ups go further than just testing, however, it also includes readjusting or replacing parts as required to restore new engine performance. Therefore, the students must strive to retain their knowledge of the tools and their functions alone with the preventive maintenance information they have been introduced to, in order to do a good tune-up job.

1-2-15

STUDY QUESTIONS

1. Prepare a step-by-step list of how to tune-up an engine.
2. In the shop, follow the procedures you have listed on a car assigned to you by the instructor.
3. Study the operating instructions manual for the King Ignition Analyzer Model.

1-2-16a

TEST SHEET

ENGINE TUNE-UP

DIRECTIONS: Place the correct answer to each of the following questions.

1. Why is the tune-up procedure more important for modern engines?
2. Explain what, in general, engine tune-up means.
3. Why must you blow the dirt and carbon out from around the spark plugs before removing them?
4. How is the compression test made?
5. Describe how to check the ignition distributor?
6. Explain how to check the battery?
7. Explain how to make a cylinder-balance test.
8. Name four meters found on the King ignition analyzer.
9. What source of power does the analyzer operate on?
10. List three components that are found in engine tuning system.
11. What does TDC stand for in power machines language?

UNIT IX

GENERAL ENGINE

1-0-0 At the end of the job, the students will apply their knowledge of General Engine by scoring 70% or above on a teacher-made test

1-1-0 For the 100 minutes, the project teacher will provide activities on engine measurements as monitored by the project monitoring system.

1-1-1 The project teacher will demonstrate performance measurements of work, energy, power, horsepower, and torque.
1-1-2 Solve problem dealing with horsepower, work, mechanical efficiency and rated horsepower.
1-1-3 Use transparencies to explain piston displacement and cylinder bore.
1-1-4 Check the compression on three different size cylinders and report your results.

1-2-0 For 100 minutes, the project teacher will provide activities on engine types as monitored by the project monitoring system.

1-2-1 The project teacher will show different types of engines, and explain their functions.
1-2-2 The students will make reports on engine designs and valve arrangements.

1-3-0 For 300 minutes, the project teacher will provide activities on disassembling and assembling an automobile engine as monitored by a progress chart.

1-3-1 Obtain correct manufacturer's shop manual to match engine.
1-3-2 Follow procedure of engine disassembly.
1-3-3 Clean and inspect all parts for wear.
1-3-4 Have instructor to check job at this point.
1-3-5 Assemble engine with new gaskets.
1-3-6 Adjust valves to manufacturer's specifications.
1-3-7 Install carburetor and make all necessary adjustments.
1-3-8 Have instructor to check completed job.
1-3-9 Clean work station.

1-4-0 For 200 minutes, the project teacher will provide activities on reading micrometers as monitored by the project monitoring system.

1-4-1 Have students to learn the names of parts that make up a micrometer.
1-4-2 The project teacher will demonstrate reading the micrometer by measuring a piece of material (example- a sheet of paper).
1-4-3 Have students to study the four steps used in reading the micrometer.
1-4-4 Have students to study about inside calipers, outside calipers, dividers and feeler gauges.
1-4-5 Have students to measure the diameter of several shafts, using an outside micrometer and an outside caliper.
1-4-6 The project teacher will demonstrate how to use the feeler gauge and inside caliper.
1-4-7 Answer questions on engine measurement (Handout 1-4-7)

1-5-0 For 200 minutes, the project teacher will provide activities on engine operations as monitored by the project monitoring system.

1-5-1 The students will study the engine cylinder design.
1-5-2 The power mechanic instructor will teach engine cylinders using charts and slides for teaching aids.
1-5-3 Have the students to secure an in-line six cylinders and a V-8 cylinder block and observe the cylinder.
1-5-4 Teach the students how to remove ring groove and hone the cylinder.
1-5-5 Require the students to take measurements from the cylinder with the micrometer.
1-5-6 Check the cylinder for cracks.
1-5-7 Study the movable metal plug called the piston, that fits snugly into the open end of the cylinder.
1-5-8 Require the students to study the piston ring groove.
1-5-9 Have students to study the piston ring groove.
1-5-10 The students will observe the piston and identify the compression and oil control ring groove.
1-5-11 The students will study the strokes that take place in the cylinder.
(a) Intake stroke
(b) Compression stroke
(c) Power stroke
(d) Exhaust stroke
1-5-12 The power mechanic teacher will demonstrate operations of the piston by means of a connection rod to the crankshaft.
1-5-13 Require the students to study engine rebuilding.
1-5-14 Answer questions on engine operations (Handout 1-5-14)

1-6-0 For 100 minutes, the project teacher will provide activities on engine valves.

1-6-1 The project teacher will explain the types of valves.
1-6-2 The students will give reports on valves and their functions.
1-6-3 The project teacher will show transparencies on valves within a cylinder and explain how they operate.

1-6-4 The project teacher will dicuss and explain valve lifters.
1-6-5 The project teacher will demonstrate how valves are timed, and explain how important correct timing is for good engine performance.
1-6-6 Have students discuss engine strokes.

1-7-0 For 100 minutes, the project teacher will provide activities on reciprocating to rotary motion.

1-7-1 The project teacher will use slides to explain reciprocating motion.
1-7-2 The students will discuss the effect of reciprocating motion.
1-7-3 The students will secure an engine (small engine) and disassemble it to the point where reciprocating motion can be seen.
1-7-4 Answer study questions on reciprocating motion. (Handout 1-7-4)

1-8-0 For 200 minutes, the project teacher will provide activities on engine valves as monitored by the project monitoring system.

1-8-1 The project teacher will secure an engine block for students to practice on the servicing of the valve train.
1-8-2 Drain cooling system and disconnect upper radiator hose from engine.
1-8-3 Remove air cleaner and disconnect accelerator rod, fuel line, air and vacuum hoses from carburetor.
1-8-4 Remove or move aside lines and hoses as necessary to get at the cylinder head.
1-8-5 Disconnect spark-plug wires and temperature sending unit wire.
1-8-6 Remove crankcase ventilating system and on air-injection systems, disconnect the air hose at the check valve. Then remove the air-supply tube assembly.
1-8-7 If V-8 engine, the carburetor and intake mainifold must be removed.
1-8-8 Remove rocker-arm cover or covers.
1-8-9 On the engine with the rocker arms supported on shafts, remove the shaft assembly or assemblies, and then remove the push rods in sequence.
1-8-10 Remove head bolts and take head off engine.
1-8-11 Remove valves and springs from head, (keeping them in proper sequence so that they can be put in the same spots from which they were removed).
1-8-12 Check valves and valve seats, grind seats and reface valves as necessary. Check valve seat. Touch up valve stem ends if necessary.
1-8-13 Check valve guides for wear. Clean, reface or ream for larger valve if necessary.
1-8-14 Replace valves and springs in head.
1-8-15 Install head, push rods, rocker arms, covers, and other parts removed to manufacturer's specification.

1-9-0 For 100 minutes, the project teacher will provide activities on servicing valves.

1-9-1 Clean the carbon off the valves. Use a wire brush or buffing wheel, (wear goggles), and do not mix the valves after servicing them.
1-9-2 Secure manual with valves specification and check the following for wear:
  (a) Valve stem
  (b) Valve face
  (c) Valve head
  (d) Valve guide
1-9-3 Have students reface valves.
1-9-4 Have students reface valve seats.
1-9-5 Have students check valve seats for concentricity.
1-9-6 Have students to test valve seating.

1-10-0 For 100 minutes, the project teacher will provide activities on action in the cylinders, as monitored by the project montoring system.

1-10-1 The project teacher will show slides on action in a cylinder.
1-10-2 The students will study the different strokes of an engine.
1-10-3 The students will measure the bore of a cylinder.
1-10-4 The students will discuss the types of rings and their function.
1-10-5 Students will check piston clearance in the cylinder head and side.
1-10-6 Check ring gap clearance.
1-10-7 The instructor will show slides to illustrate the function of connecting rods in relation to the piston.

1-11-0 For 100 minutes, the project teacher will provide activities on multiple cylinder engines, as monitored by the project monitoring system.

1-11-1 The instructor will discuss multiple cylinder engines and their advantages.
1-11-2 The instructor will show slides on multiple cylinder engines and explain their functions.
1-11-3 From a series of engines, the students will identify multiple cylinder engines.
1-11-4 The instructor will use slides to aid in explaining the purpose of the flywheel.
1-11-5 Secure a small engine, crank the engine and observe its performance.
1-11-6 Answer study questions on multiple-cylinder engines. (Handout 1-11-6).

General Information on Black and Decker Valve Reconditioning Machine

1. Motors and current - your unit will operate on Direct Current (D.C.) or Alternating Current (A.C.) of 25,40,04,60 cycles, at the specified Voltage. Nameplate Voltages will operate on Voltage range given below.
   115 Volt -- Range 110 to 120
   220 Volt -- Range 210 to 230

   Check the nameplate Voltage of your Unit with the voltage of your supply line. Serious damage can result if supply line voltage does not fall within the ranges given above. In other words, do not plug your machine in a 220 Volt outlet, if the machine is designed to operate on 110 Volt.

2. Lubrication - closed type, grease sealed ball bearings are used in Vibro-Centric Drivers and have sufficient lubrication packed in them at the factory to last the life of the bearing. The gear case of the Driver should be cleaned about every 60 days under normal usage. Add enough special grease to half fill the gear case after each cleaning.

   Lubricating the Refacer---your valve refacer requires a few drops of high-grade light oil in the oil cups, which are located in the work table, wheel housing, workhead and under the belt guard. Add oil after every 50 hours of use, or more often, depending upon usage.

3. Grounding - Every electric tool should be grounded while in use to protect the operator against shock. Proper grounding is a good habit to develop under all circumstances, but is especially important where dampness is present.

   A. See page 3 of Use and Care Valve Reconditioning Equipment Manual.

VALVE RECONDITIONING EQUIPMENT COMPONENTS

1. Driver
2. Pilot wrench
3. Self-centering pilot
4. Plug pilot
5. Pilot pin
6. Stone
7. Stone sleeves
   - A. Ball-bearing stone sleeve
   - B. Standard stone sleeve
   - C. Short standard stone sleeve
8. Valve stone dressing stand
9. Carbon cleaning brushes
10. Nylon valve guides cleaner
11. Micrometer valve stem grinding attachment

1-4-7

STUDY QUESTIONS

ENGINE MEASUREMENT

1. What is a Micrometer?
2. Name the parts of the micrometer.
3. What are feeler gauges used for?
4. What measuring instrument can be used in measuring the diameter of a shaft?
5. Describe the procedure used in measuring the diameter of a hole using an inside caliper.
6. Describe the procedure used in taking a measurement with a micrometer.
7. Name the important things to do in taking care of measuring instruments.
8. What is the bore and stroke of an engine?
9. Explain what the term "Compression ratio means".
10. Explain how piston displacement can be measured.

STUDY QUESTIONS

ENGINE OPERATION AND ACTION IN THE CYLINDER

1. Define the following:
    (a) Work
    (b) Energy
    (c) Power
    (d) Horsepower
    (e) Torque
    (f) Potential
    (g) Kinetic Energy
2. Name four cylinder arrangements.
3. Name three engine designs.
4. What is meant by engine disassembly?
5. Give two uses for the flywheel.
6. Vacuum gauge is used for what?
7. What are some causes of engine backfires?
8. Name three causes of excessive oil consumption.
9. What action takes place on the intake stroke, compression stroke, power stroke and exhaust stroke?
10. How can the compression be measured of cylinder?
11. What is meant by the term cylinder bore?

1-7-4

STUDY QUESTIONS

ENGINE VALVES

1. What is the purpose of the valves in an engine?
2. Explain the action of the valves.
3. Why is it necessary to time the valves?
4. What are valve springs used for?
5. Why should the intake valve run relatively cool?
6. What are retainers used for?
7. Explain the purpose of cam lobe.
8. Name two types of valve lifters.
9. Explain the procedure in refacing valves.
10. Explain the action of the exhaust valves.
11. Name two types of valves.

STUDY QUESTIONS

MULTIPLE-CYLINDER ENGINES

1. Explain why a flywheel is used.
2. What is a vacuum?
3. Describe the actions in the cylinder during each of the four strokes.
4. Describe the construction and operation of the valves.
5. What are the four stages, or strokes of engine operation?
6. Explain how the reciprocating motion of the piston is changed to rotary motion.
7. Name two advantages of having multiple-cylinder engines.

UNIT TEST

GENERAL ENGINE

1. What measuring instrument can be used in measuring the diameter of a shaft?

2. Name two types of calipers. Explain the function of each.

3. Define the following:

    (a) kinetic energy

    (b) work

    (c) potential energy

    (d) torque

    (e) horsepower

4. Name three engine designs.

5. Explain engine disassembly.

6. Define cylinder bore.

7. Explain the following:

    (a) purpose of valves in an engine

    (b) action of the valves

    (c) timing the valves

8. Explain the procedure in refacing valves.

9. Give two uses of the flywheel. Why is it used?

10. What are some causes of engine backfire?

UNIT X

BRAKING SYSTEM

1-0-0 Upon completion of the job the students will apply their knowledge of an automobile braking system by scoring 70% or above on a teacher made test.

1-1-0 During one class period the power mechanics instructor will demonstrate how friction is used in the braking system as monitored by the project monitoring system.

1-1-1 Demonstrate how friction is used in the car braking system.
1-1-2 Discuss how friction slows the rotation of the wheels.
1-1-3 Discuss how friction between tires and road slow the motion of the car.
1-1-4 Discuss the bad effects if the wheels were locked.
1-1-5 Administer an oral quiz on friction in the braking system.

2-0-0 At the end of the job the students will apply their knowledge of hydraulic principles by scoring 70% or above on a teacher made test.

2-1-0 During one class period the power mechanics instructor will demonstrate how hydraulic principles are used in the braking system as monitored by the project monitoring system.

2-1-1 Demonstrate the incompressibility of liquids.
2-1-2 Demonstrate how motion can be transmitted by liquids.
2-1-3 Demonstrate how pressure can be transmitted by a liquid.
2-1-4 Demonstrate how hydraulic valves can be used to produce constant pressure from a variable source.

3-0-0 Upon completion of the job the students will apply their knowledge of brake action by scoring 70% or above on a teacher made test.

3-1-0 During one class period the power mechanics instructor will demonstrate brake action as monitored by the project monitoring system.

3-1-1 Demonstrate the parts of a braking system using a model.
3-1-2 Demonstrate how movement of the brake pedal downward forces a piston to move in the master cylinder.
3-1-3 Show how this movement downward in turn causes the liquid to move through the brake lines to the wheel cylinders.
3-1-4 Follow the liquid to each of the wheel cylinders.
3-1-5 Discuss what happens when the fluid makes its way to the wheel cylinder.
3-1-6 Describe the material used on many brake shoes.
3-1-7 Describe what happens when the brakes fail because of heat.
3-1-8 Explain the reason for applying more brake pressure to the front wheel than to the rear wheel.
3-1-9 Administer an oral quiz on brake action.

4-0-0 Upon completion of the job the students will apply their knowledge of the master cylinder by scoring 70% or above on a teacher made test.

4-1-0 During one class period the power mechanics instructor will describe the operation of the master cylinder as monitored by the project monitoring system.

4-1-1 Show a sectional and disassembled view of the master cylinder.
4-1-2 Explain the use of a check valve.
4-1-3 Label the basic parts of the master cylinder.
4-1-4 By illustration show how the springs pressure in the master cylinder forces the piston back in its cylinder thus allowing brake fluid to flow back into the cylinder.
4-1-5 Adminster an oral quiz on the master cylinder.

5-0-0 Upon completion of the job the student will apply their knowledge of wheel cylinders by scoring 70% or above on a teacher made test.

5-1-0 During one class period the power mechanics instructor will describe the operation of a wheel cylinder as monitored by the project monitoring system.

5-1-1 Use an overhead projector to illustrate a wheel cylinder.
5-1-2 List the basic parts of a wheel cylinder.
5-1-3 Describe the method in which the hydraulic pressure forces the brake shoes against the drum.

6-0-0 Upon completion of the job the student will apply their knowledge of disc brakes by scoring 70% on a teacher made test.

6-1-0 During one class period the power mechanics instructor will describe the operation of disk brakes as monitored by the project monitoring system.

6-1-1 Describe the difference between disc and shoe brakes.
6-1-2 Explain the basic operation of disc brakes.
6-1-3 List the basic parts of a disc brake.
6-1-4 Demonstrate the disassembling and assembling of a disc brake.
6-1-5 Administer an oral quiz on disc brakes.

7-0-0 Upon completion of the job the students will apply their knowledge of power brakes by scoring 70% or above on a teacher made test.

7-1-0 Power mechanics instructor during one class will introduce theory and maintenance of power brakes as monitored by the project monitoring system.

7-1-1 Discuss the relationship between power brakes and the regular braking system.
7-2-2 List the advantages of power brakes.

7-1-3 Disassemble a power brake booster cylinder.
7-1-4 Describe the function of each part of the booster system.
7-1-5 Assemble the booster into the braking system.
7-1-6 Ask questions of students about the operation of power brakes.

8-0-0 At the end of the job the students will apply their knowledge of self-adjusting brakes by scoring 70% or above on a teacher made test.

8-1-0 During one class period the power mechanics instructor will demonstrate procedures in disassembly and assembly of self adjusting brakes as monitored by the project monitoring system.

8-1-1 Discuss the operation of self-adjusting brakes.
8-1-2 Each student will disassemble a self-adjusting brake.
8-1-3 Students will explain the use of each part and its correct location.
8-1-4 Students will assemble brake system.
8-1-5 Students will explain the method of adjustment.
8-1-6 Administer an oral quiz on self-adjusting brakes.

9-0-0 Upon completion of the job the students will apply their knowledge of dual master cylinder operation by scoring 70% or above on a teacher-made test.

9-1-0 During one class the power mechanics instructor will discuss the theory and operation of dual master cylinders as monitored by the project monitoring system.

9-1-1 Describe what would happen if the rear brake system failed.
9-1-2 Explain the reasons for having dual master cylinder.
9-1-3 Describe what would happen if the front brake system failed.
9-1-4 Question and answer session.
9-1-5 Answer study questions (handout 9-1-5)

10-0-0 Administer unit test covering Interims 1-9.

Braking System

9-1-5 Study Questions

1. What job does the master cylinder play in a braking system?
2. Why does a master cylinder have a check valve?
3. List the parts of a wheel cylinder.

   ____________________ ____________________ ____________________

4. Name 2 types of wheel cylinders.

   ____________________ ____________________

5. Is kerosine a good substitute for brake fluid? _______
6. Brake linings are made of what material? ____________________
7. What causes brake fade?
8. Which brake shoe has the longer lining? ____________________
9. Explain the difference between disc and drum brakers.

10-0-0 Test

True and False

1. ____________________ Use only high quality brake fluid.

2. ____________________ Air can be compressed.

3. ____________________ Wheel cylinders are never fastened in the brake drum.

4. ____________________ Bleeder screws are always furnished in the lines.

5. ____________________ Air pockets in the brake lines are permissible.

6. ____________________ All braking systems are front wheel only.

7. ____________________ Brakes are based on hydraulic pressure.

8. ____________________ The only difference between power and disc brakes is the drum.

9. ____________________ Emergency brakes are separated from the regular brakes.

10. ____________________ All brakes must be adjusted with a brake adjusting tool.

Fill in the blank.

1. Hydraulics is the science of liquid in ______________________________.

2. When pressure is exerted on a confined liquid, it is transmitted undiminished. This is ____________________ law.

3. Name three parts of the hydraulic system.
____________________ ____________________ ____________________

4. ______________________________ is the Central unit in which hydraulic pressure is developed.

5. ____ is a brake fluid resevoir which is a safety feature on modern automobiles.

6. The master cylinder reservior should be filled to within ________ to ____ inches of the top of the reservior depending on manufacturer's recommendations.

7. When using a dual master cylinder and the front system failed, the____________________portion of the system will stop the vehicle.

8. Master cylinder is connected to wheel cylinders by double thickness _____________________ and ________________________.

9. Name 4 parts of the braking system.

A.

B.

C.

D.

10. What material is used in brake linings?

11. Name three parts of a wheel cylinder.

A.

B.

C.

12. List the basic parts of disc brakes.

A.

B.

C.

13. List 3 advantages of power brakes.

A.

B.

C.

14. Name the reasons for having a dual master cylinder.

A. D.

B. E.

C. F.

15. Describe the functions of the booster system.

UNIT XI

FRONT END SUSPENSION SYSTEM

1-0-0 At the end of the job, the students will apply their knowledge of independent front wheel suspension by scoring 70% or above, using the factory's standards.

1-1-0 The project teacher will provide activities for 300 minutes on front end suspensions as monitored by the project monitoring system.

1-1-1 Using the charts on front end suspension, give a report on the action of individual front wheel suspension system.
1-1-2 Jack up car and secure it on safety stands.
1-1-3 Take off wheel cover.
1-1-4 Remove wheel, hub, and springs.
1-1-5 Clean suspension and replace coil springs.
1-1-6 Disassemble suspension.
1-1-7 Discuss in detail the procedure you followed in disassembling.
1-1-8 Reassemble front end suspension and coil spring.
1-1-9 Discuss in detail the procedure you followed in reassembling.
1-1-10 Align front end.
1-1-11 Answer study questions on front end suspensions. (Handout 1-1-11)
1-1-12 Evaluate (Handout 1-1-12)

1-2-0 The project teacher will provide activities for 400 minutes on rear springs and shock absorbers as monitored by the project monitoring system.

1-2-1 Jack up car and place supports under the car frame, just in front of the springs. Lower jack until all weight is off the axle housing.
1-2-2 Disconnect brake hose at the rear axle housing.
1-2-3 Disconnect shock-absorber linkages.
1-2-4 Disconnect propeller shaft if shop manual calls for it.
1-2-5 To remove a leaf spring, detach the spring from the axle housings by removing nuts, clips, washers, and bolts. Then take out shackle bolts and hanger bolt.
1-2-6 To remove a coil spring, take out the cap screws or bolts at the upper and lower ends of the spring. Some of these caps have left-hand threads, so be careful.
1-2-7 Remove shock absorbers for service. Take out the bolts attaching them to the frame. (As a rule, shock absorbers are serviced by complete replacement.)

1-2-8 Install coil springs, making sure you follow the aligning instructions given in the applicable shop manual. Make sure washer, insulators, brackets and other parts are reinstalled in the proper order.

1-2-9 Reinstall leaf spring by using procedures found in shop manual.

1-2-10 Have instructor check completed job.

1-2-11 Clean up work station.

1-2-12 Answer study questions on servicing shock absorbers.

UNIT XI

FRONT SUSPENSION

GENERAL INFORMATION

The front suspension is more complicated than the rear wheel suspension. The front wheels move up and down with respect to the car frame, (for spring action), but also must be able to swing at various angles to the car frame for steering.

We have many types of front wheel suspensions: (1) Independent front suspension; (2) Ball joint front suspension; (3) Coil spring front suspension; and (4) Solid front suspension, that are used in heavy-duty vehicles. These heavy-duty vehicles use leaf springs.

Along with front suspension, you have rear suspension that is made up of leaf springs, shock absorbers, coil springs and sometimes torsion bars.

The purpose of shock absorbers is to aid in gaining satisfactorily smooth rides. Of course, they cannot accomplish this smooth ride alone. You must have springs to absorb some of the shock.

STUDY QUESTIONS

FRONT SUSPENSION

1. What is the basic function of the suspension system?

2. Describe the coil spring.

3. What is the great advantage of the independent suspension system?

4. Name the basic parts of the independent front wheel suspension system.

5. How does the stabilizer bar work?

6. Why is wheel alignment very important?

7. Define the following:

   (a) Caster

   (b) Camber

   (c) Toe-in

8. Name three types of springs used in automobile suspensions.

1-1-12

UNIT XI

FRONT SUSPENSION TEST

1. What could cause excessive play in the steering system?
2. What could cause hard steering?
3. What could cause the car to pull to one side during braking?
4. What could cause a hard ride?
5. Explain how to check shock-absorber action.
6. Describe two methods of making caster adjustments.
7. What is the purpose of the stabilizer shaft?
8. What is the purpose of the car springs?
9. Name three types of shock absorbers.
10. Describe a torsion bar suspension system.

UNIT XII

TRANSMISSION

1-0-0 At the end of the job, the students will apply their knowledge of transmissions by scoring 70% or above, on a teacher-made test.

1-1-0 For 200 minutes, the project teacher will provide activities on the purpose of transmissions, as monitored by the project monitoring system.

1-1-1 The project teacher will demonstrate and discuss the purpose of transmissions.
1-1-2 The project teacher will show transparancies on Standard Transmissions and discuss them.
1-1-3 The project teacher will show pictures of various gear ratios and explain how ratios are obtained in order to obtain maximum speed or power.

1-2-0 For 500 minutes, the project teacher will provide activities on the operation of transmissions as monitored by the project monitoring system.

1-2-1 Obtain either motor manual or manufacturer's manual for recommended procedure.
1-2-2 Clean outside of transmission case, (secure a place).
1-2-3 Unscrew and remove transmission oil, fill and drain plugs.
1-2-4 Drain the gear oil from case.
1-2-5 Install drain plugs and fill with kerosene and shake transmission.
1-2-6 Turn input shaft rapidly to loosen old lubricant and clean gears.
1-2-7 Drain case thoroughly.
1-2-8 Follow disassembly and assembly of transmission as recommended by the namufacturer's manual procedure.
1-2-9 Check with instructor.
1-2-10 Install new gaskets and replace transmission cover.
1-2-11 Answer questions on transmissions.

1-3-0 For 100 minutes, the project teacher will provide activities on servicing automatic transmissions as monitored by a progress chart.

1-3-1 Check linkage on automatic transmissions.
1-3-2 Remove and clean oil pan on automatic transmissions.

1-3-3 Adjust bands on automatic transmissions.
1-3-4 Clean filter on automatic transmissions.
1-3-5 Replace filter on automatic transmissions.
1-3-6 Evaluation (Handout 1-3-6).

GENERAL INFORMATION

TRANSMISSION

The transmission is a gear box where various gear ratios are obtained in order to obtain maximum speed or power.

A typical transmission consists of a cast iron or aluminum housing, four shafts, bearings, gears, synchronizing device, and a shifting mechanism.

Basically, in addition to the metal housing, the automatic transmission assembly consists of:

1. A fluid coupling or torque converter to transmit power from the engine to the transmission proper
2. One or more planetary gear sets and shafts to secure the necessary forward and reverse speed
3. A series of brake bands and multiple disc clutches designed to control the planetary gear sets
4. Hydraulic servos and pistons to actuate the band and clutches
5. One or more oil pumps to provide the necessary hydraulic pressure
6. Some means of cooling the oil
7. A manual control system used by the operator to select certain speed ranges

STUDY QUESTIONS

TRANSMISSION

1. Make five sketches showing only the transmissions gears that are in mesh in the four gearshift positions and in neutral.

2. Make a list of all types of transmission trouble, together with their possible causes and corrections.

3. Write the procedures for the following:
   (a) transmission removal

   (b) overhaul

   (c) reinstallation

   (d) adjustment

4. Describe a fluid coupling.

5. List the various precautions to observe when engaged in transmission service.

UNIT TEST

TRANSMISSION

1. What is the purpose of the transmission?
2. How does a transmission multiply torque?
3. Name the various gears that are available in a standard transmission.
4. What are the approximate ratios of these gears?
5. Explain how the transmission works in each gear.
6. Name the four shafts used in the transmission.
7. What is the purpose of synchromesh devices?
8. How does synchromesh work?
9. What lubricates a transmission?
10. Explain a constant mesh gear.
11. What is an overdrive?
12. Define the following:
    a) planetary
    b) sun gear
    c) internal gear
13. Describe a freewheeling mechanism used in an overdrive.
14. Is an overdrive suited to ALL cars? If so or if not-why.

UNIT XIII

DRIVE LINE

1-0-0 At the end of the job the student will apply his knowledge of the function of the propeller shaft by scoring 70% on a teacher-made test.

1-1-0 The project teacher will provide activities for one class period on the Functions of the Propeller Shaft as monitored by a teacher-made monitoring form.

1-1-1 The students will read the function of the propeller shaft.
1-1-2 Require the students to list all the parts of the shaft.
1-1-3 Connect the propeller shaft to the transmission and differential by means of universal joints.
1-1-4 Answer questions on Drive Line (Handout 1-1-4).

1-2-0 The project teacher will provide activities for one class period on universal joints as monitored by the project monitoring system.

1-2-1 The teacher will demonstrate the need for universal joints.
1-2-2 Study the types of Universal joints.
  (a) The cross and roller universal joints is in common use.
  (b) It consists of a center cross (sometimes referred to as a Spider) and two yokes (sometimes called Knuckles).
  (c) Another type of universal, called the Ball and Trunion.
1-2-3 The students will disassemble and assemble a universal joint several times.
1-2-4 List and study the main parts of the universal joint.
1-2-5 The teacher will demonstrate how to lubricate the universal joint.

1-3-0 The project teacher will provide activities for 45 minutes on the types of drive lines and their function as monitored by the project monitoring system.

1-3-1 The instructor will discuss the two types of lines.
  (a) The Hotchkiss type of drive is used when the rear axle drive thrust is transmitted to the frame through the springs, or via control arms.
  (b) Torque Tube Drive
1-3-2 Require the student to write a report on the two types of drive lines.
1-3-3 Evaluation (Handout 1-3-3).

GENERAL INFORMATION ON DRIVE LINES

In order for the transmission output shaft to drive the differential pinion gear shaft, it is necessary to connect these two units by means of a propeller shaft. The propeller shaft must be flexible, when the rear wheel strikes a high or low place in the road, the rear axle housing moves up or down. The axle housing moves up or down, in relation to the frame, even on a smooth road.

A universal joint is needed; it is clear that a solid line would be bent and finally broken as the angle of drive moves up and down. To allow the drive line, or the propeller shaft, to move without breaking, a flexible joint is used, called a Universal Joint. Drive line changes length, as the rear axle moves up and down, it swings on an arc that is different from that of the drive line. As a result, the distance between transmission and rear axle will change to some extent. To allow the drive line to adjust to these variations in length, a slip joint is often used.

The forward end of the propeller stub shaft has a series of splines cut into it.

The Hotchkiss type of drive is used when the rear axle drive thrust is transmitted to the frame through the springs. The Hotchkiss drive consists of an open propeller shaft secured to the transmission output shaft, and to the differential pinion gear shaft. Front and rear universal joints are used.

When the rear axle housing thrust is not carried to the frame through the springs or by control rods, a torque tube drive is used. The torque tube is a hollow steel tube that reaches from the transmission to the rear axle housing. One end of the torque tube is secured to the axle housing by a ring of bolts.

STUDY QUESTIONS

DRIVE LINES

1. Make a sketch of a universal joint, and write an explanation of its operation.
2. Write a brief article explaining why rear end torque occurs.
3. What function does the propeller shaft perform?
4. Write a brief explanation of how the power from the transmission is delivered to the rear wheels.

DRIVE LINE TEST

1. What is the name of the unit that connects the transmission output shaft to the differential pinion gear shaft?

2. As the rear axle housing moves up and down, in relation to the transmission, what unit allows the necessary flexing of the drive line?

3. What advantage is there in making the propeller shaft in two pieces?

4. What are two common types of drives?

5. In a two piece drive line, a ______________________ bearing must be used.

6. Name two types of Universal Joints.

7. When the rear axle drive thrust is through the springs, a ______________ type of drive may be used.

8. Most propeller shafts are solid. (True or False)

9. What is a torque ball and what is its purpose?

10. Why must the line be carefully balanced?

11. Wheel drive thrust is carried to the frame in three ways. Name them.

12. What would happen if the two propeller shaft universal yokes were not in the same plane?

13. What absorbs the rear end torque in the Hotchkiss drive?

14. What is the purpose of a slip joint?

15. What is the purpose of the universal joint?

UNIT XIV

DIFFERENTIAL AND REAR AXLES

1-0-0 At the end of the job the students will apply their knowledge of functions of differentials by scoring 70% on a teacher-made test.

1-1-0 The power mechanics instructor will provide activities for 100 minutes on the functions of the differentials as monitored by the project monitoring system.

1-1-1 Discuss the operation of the differential.
1-1-2 Describe what happens in the differential when rounding a corner.
1-1-3 Describe the different types of differentials.
1-1-4 Explain the function of the major differential parts.
1-1-5 Answer questions on differential and rear axles. (Handout 1-1-5)
1-1-5a Administer a teacher-made quiz covering differentials.

2-0-0 At the end of the job the students will apply their knowledge of differential gearing by scoring 70% on a teacher-made test.

2-1-0 The power mechanics instructor will describe the theory and function of 4 types of gears as monitored by the project monitoring system for 100 minutes.

2-1-1 Discuss the benefits of using hypoid gearing in the ring and pinion.
2-1-2 Explain the function of hypoid gearing.
2-1-3 Demonstrate Spur Bevel gearing.
2-1-4 Demonstrate Spiral Bevel gearing.
2-1-5 Study ring & pinion gear.
2-1-6 Administer teacher-made quiz on differential gearing.
2-1-7 Disassemble a differential study parts and assemble correctly.
2-1-8 Show filmstrip on differentials and discuss.
2-1-9 Require the students to identify the following parts of the differential as they are assembled in a unit:

A. Companion flange
B. Pinion oil seal
C. Pinion front bearing
D. Drive pinion
E. Pinion rear bearing
F. Differential carrier
G. Axle shaft
H. Differential side gear
I. Ring gear

3-0-0 The power mechanics instructor will demonstrate the type of rear axles and overhaul procedures as monitored by project monitoring form for three class periods.

3-1-1 The students will study the dead axles and live axles and list their operations.
3-1-2 Discuss the three general types of live axles.
    A. Semifloating
    B. Three - quarter - floating
    C. Full - floating
3-1-3 Discuss Gear Ratio as found on the ring gear and the pinion.
3-1-4 The students will count the teeth on a ring gear and also count the teeth on a pinion from the same differential and indicate the ratio found.
3-1-5 Have students to trouble-shoot the differential.
3-1-6 The students will follow overhaul procedures for rear ends.
3-1-7 Require the students to study differential service sheet attached.
3-1-8 The instructor will set up a rear end and differential assembly for class instruction.
3-1-9 Unit test.

GENERAL INFORMATION ON
DIFFERENTIALS AND REAR AXLES

The rear axle assembly has several important functions. It must hold the two rear wheels on, keep them upright, and drive them forward or backward. It must drive both wheels in such a manner that one can turn faster than the other, yet both must receive torque. It must absorb the driving force of the wheels, and transmit it to the frame through springs, supports the weight of the car, and forms the foundation upon which the rear wheel brakes are constructed.

The rear axle housing is usually made of stamped steel parts welded together, or, the center section of the housing may be made of cast steel. Two basic types have heen used: The Banjo type housing and the Split housing consisting of two or more pieces. The steel axles are used. These are placed inside the housing. Their inner ends almost, and in some cases do, touch. The outer ends protrude out of the housing and form a base upon which the wheel hubs are attached. The inner ends are splined and are supported by the differential assembly.

In that the rear wheels turn at different speeds when rounding the slightest corner, it is necessary to employ a differential to drive the axles to both receive power, yet are free to turn at different speeds. A splined axle side is placed on the inner splined end of each side. The axle side gear is supported by the differential case. The side gear is free to turn in the case.

Since the ring gear has many more teeth than the drive pinion, a considerable gear reduction is effected in the differential. The gear ratios vary somewhat on different cars, depending on car and engine design. Ratios of 3.36:1 upward to 5:1 are used on passenger cars. This means that the pinion gear turns 3.36 to 5 times in order to cause the ring gear to rotate once.

A humming noise in the differential is often caused by improper drive-pinion or ring-gear adjustment, which prevents normal tooth contact between the gears. This produces rapid gear-tooth wear, so that the noise will gradually take on a growling characteristic. Correction should be made before the trouble progresses to this extent, since abnormal tooth wear will require pinion and gear replacement. If the noise is most evident when the car is being accelerated, the probability is that there is heavy heel contact on the gear teeth; the ring gear must be moved near the drive pinion. A knocking noise will be heard if the bearing or gears are damaged or badly worn.

1-1-5

DIFFERNTIALS AND REAR AXLES STUDY QUESTIONS

1. What is the purpose of the differentials?

2. List the parts in a differential in the order in which they transmit power from the propeller shaft.

3. Name three types of gearing that have been used in differentials.

4. What occurs to the differential - pinion gear when the car rounds a curve?

5. How is the pinion pre-load adjusted?

6. What method is used in adjusting the ring gear backlash?

7. What are two basic types of axles? In what way do they differ?

8. What does a humming noise in the differential often indicate?

9. Why is a differential necessary?

10. What type of rear axle uses universal joints and open axles?

11. When differential noise is most evident during car acceleration, what's the probable trouble?

JOB

OVERHAUL REAR END PROCEDURES

Precautions:

1. Always oil bearings before installing.
2. Always install new gears in sets.
3. Soak new leather oil seals in oil before installing.
4. Always replace collapsible spacers.

Procedures:

1. Jack up the car and secure on stands and drain differential.
2. Remove the rear wheels.
3. Remove the rear drums.
4. Remove the rear axles.
5. Disconnect the rear universal joint and remove the drive shaft.
6. Remove the differential case and ring gear assembly from the differential carrier.
7. Mark and remove the differential bearing caps assembly from housing.
8. Remove ring gear.
9. Remove the universal joint flange and pull pinion out of the housing.
10. Remove the rear pinion bearing and washer and front bearing and seal.
11. Clean all parts for wear, roughness and scores.
12. Remove ring gear from the case.
13. Clean all parts in cleaning fluid.
14. Have instructor check at this point.
15. Install ring gear on case.
16. Place washer on pinion and press rear bearing on pinion.
17. Apply light oil to all parts.
18. Place pinion spacer and shim in housing.
19. Install front bearing and oil seal.
20. Install universal joint flange and tighten to specified torque where shims are used to adjust the preload on the pinion bearings, then check the pre-load with a scale.
21. Install differential bearing adjusting nuts and bearing case.
22. Install ring gear and differential case in carrier.
23. Adjust the backlash.
24. Check tooth contact with red lead.
25. Have instructor check at this point.
26. Replace differential carrier in rear axle housing.
27. Install drive shaft and connect universal joint.
28. Replace rear axles and drums.
29. Replace wheels and fill differential with lubricant.
30. Check and double check all work.
31. Clean work station.
32. Check the rear end to see if it is operating correctly.
33. Have instructor check completed job.

3-1-7

DIFFERENTIAL SERVICE

The students will study Rear Axle trouble.

Possible causes of noisy gears listed below
1. Insufficient or unsuitable lubricant
2. Improper gears and bearings adjustments
3. Pinion shaft bearing chipped or rough
4. Rounded ring gear warped
5. Broken differential bearing
6. Worn gear teeth
7. Gears not meshing
8. Spring axle housing
9. Axle shaft spacer block defected
10. Broken differentials carrier housing

Possible cause of gear noise when decelerating

1. Lack of backlash between gears
2. Excessive end play in differential bearings
3. Broken ring gear
4. Improper tooth contact of gears
5. Sprung differential housing

Possible causes of continous axle hum:

1. Faulty lubrication
2. Differential bearing improperly adjusted
3. Loose or broken differential - bearing cup
4. Loose drive - pinion flang - nut
5. Drive - pinion rear bearing defected

3-1-9

UNIT TEST

DIFFERENTIALS AND REAR AXLES

1. For purposes of study, the rear axle assembly can be broken into three basic units or sections. Name them.
2. Describe two methods of attaching the wheel or wheel hub to an axle.
3. Name the three different types of axles and describe them.
4. Why is a differential necessary?
5. Name the parts that make up the differential assembly.
6. Describe the action of the differential in straight-line driving.
7. Describe the action of the differential when rounding a corner.
8. What is the purpose of the differential carrier?
9. How is the differential case supported in the carrier?
10. Of what use is the special traction type of differential?
11. What parts do you find in the traction differential that you do not find in the standart model?
12. Explain the action of the traction differential when rounding a corner.
13. What is a hypoid gear setup as used in the differential?
14. Why is a hypoid used?
15. How do you determine the gear ratio used in the rear axle?
16. What factors limit your choice of gear ratio?
17. What type of rear axle uses universal joints and open axles?
18. How is the rear axle lubricant contained or kept in the housing?
19. Explain how the rear axle assembly is lubricated.
20. Outer rear wheel bearings are lubricated in three ways. Name them.

UNIT XV

AIR CONDITIONING

1-0-0 At the end of the job the students in power mechanics will apply their knowledge of air conditioning by scoring 70% on a teacher-made test.

1-1-0 The project teacher will provide activities related to installing air conditioning systems and trouble shooting problems that may develope in old units for 500 minutes as monitored by the project monitoring system.

1-1-1 By use of chart, the instructor will point out the parts of an air conditioning system explaining the functions of each part, namely:
(a) Drive belt
(b) Matnetic clutch
(c) Compressor
(d) Refrigerant
(e) Evaporator
(f) Condenser

1-1-2 Run engine at 1500 r.p.m. and allow air conditioner to operate for five minutes.

1-1-3 Observe the sight glass. If it is foamy it indicates a shortage of refrigerant. Cut off engine.

1-1-4 Light and adjust the leak detector according to the leak detector instructions-usually a pale blue flame.

1-1-5 Check for leaks over the entire system using the leak detector. The color of the flame will turn a yellow green when a small leak is encountered and brilliant blue or purple on large leaks. (Caution: Do not breathe the fumes of the leak detector when a leak is encountered as they are poisonous. Also on some places on the system it is dangerous to use the leak detector and soap solution should be used).

1-1-6 After the leak is found if it is at a connection tighten the connection and re-check for leaks. If the line has to be removed or replaced, the unit will have to be discharged first.

1-1-7 Remove the valve stem covers from the compressor service valve and seat the valves by turning them counterclockwise until they seat.

1-1-8 Remove the protective caps from the valve ports and connect the gauge low pressure gauge to low pressure valve port and high pressure gauge to the high pressure valve port. (NOTE: Systems employing a Schrader valve use a special adaptor on hose connections.)

1-1-9 Position a container to receive any oil discharged from the loose center line of the gauge set, so an equivalent amount of new oil may be added.

1-1-10 With gauges installed, turn both gauge hand valves clockwise until they are seated.

1-1-11 Open the compressor service valves slightly by turning them clockwise.

1-1-12 Now crack the gauge valves slightly by turning them counterclockwise. (Note: As the refrigerant escapes through the center line a hissing will be heard. Do not allow the refrigerant to rush out as that will force the compressor oil out with the refrigerant.)

1-1-13 Allow all the refrigerant to escape and then seat the service valves counterclockwise and the gauge valves clockwise.

1-1-14 Repair or replace the leaking line.

1-1-15 Before recharging, the unit will have to be evacuated. There are two methods; if the vacuum pump method is used proceed as follows. If the compressor method is used follow the shop manual. (NOTE: Vacuum pump recommended)

1-1-16 Install gauge set as for discharging the system.

1-1-17 Connect the center line of the gauge set to the vacuum pump.

1-1-18 Turn the high pressure compressor service valve two (2) turns clockwise.

1-1-19 Turn the low pressure service valve two (2) clockwise.

1-1-20 Open the low pressure gauge valve fully counterclockwise.

1-1-21 Open the high pressure gauge valve fully counterclockwise.

1-1-22 Turn on the vacuum pump and open the vacuum pump control valve.

1-1-23 Run the vacuum pump until 28 to 29 inches of vacuum is obtained and continue to run the vacuum pump for 15 minutes.

1-1-24 If 28 to 29 inches of vacuum cannot be held it indicates a leak in the system.

1-1-25 After 15 minutes close off vacuum pump control valve.

1-1-26 Close both valves fully clockwise on gauge set and turn off the vacuum pump.

1-1-27 Disconnect the center line of the gauge set from the vacuum pump.

1-1-28 Connect the center line of the gauge set to the Freon drum.

1-1-29 Open the Freon drum valve and loosen the center line of the gauge set at the gauge and purge the line and retighten the center line at the gauge set.

1-1-30 Open the low pressure valve on the gauge set and charge the system to Freon drum pressure.

1-1-31 Close the low pressure valve of the gauge set fully clockwise.

1-1-32 Close the Freon drum valve clockwise.

1-1-33 Disconnect the center line from the Freon drum and place in a container to catch oil.

1-1-34 Open the high pressure valve of the gauge set counterclockwise and allow the system to discharge through the center line.

1-1-35 Connect the center line to the vacuum pump and open the vacuum pump control valve.

1-1-36 Open the low pressure valve of the gauge set counterclockwise.

1-1-37 Turn on the vacuum pump and run until 28 to 29 inches of vacuum is obtained and continue to run the vacuum pump for 10 minutes. (NOTES: This second evacuation aids in the removal of contamination.)

1-1-38 Turn off the vacuum pump control valve.

1-1-39 Close both gauge valves of the gauge set fully clockwise and turn off vacuum pump.

1-1-40 Disconnect the center line of the gauge set from the vacuum pump and connect to the Freon drum.

1-1-41 Open the Freon drum valve.

1-1-42 Loosen the center line of the gauge set at the gauge and purge the center line and retighten the center line.

1-1-43 Open the low pressure gauge valve and charge system to drum pressure.

1-1-44 Start the engine and push the air conditioning controls to the cold position and operate the engine at approximately 1000 r.p.m.

1-1-45 Observe the sight glass and charge to capacity. The sight glass should now be clear. Note if sight glass is still foamy.

1-1-46 Close the low pressure gauge valve fully clockwise.

1-1-47 Check reading on the high and low pressure gauges and compare to manufacturer's specification.

1-1-48 Place a thermometer in front of condenser and also one in the cool air outlet inside the car.

1-1-49 Compare thermometer temperature reading in front of the condenser and the head pressure of the compressor with the performance data chart.

1-1-50 Compare thermometer temperature reading from the cool air discharge nozzel inside the car and the low pressure (or suction pressure) of the compressor to the performance data chart.

1-1-51 Have instructor check job.

1-1-52 Open the compressor high pressure service valve fully counterclockwise.

1-1-53 Open the compressor low pressure service valve fully counterclockwise.

1-1-54 Close Freon drum valve clockwise.

1-1-55 Discharge the gauge set hoses and disconnect gauge set.

1-1-56 Replace the protective caps over the compressor service valve stems and tighten.

1-1-57 Replace the protective caps over the compressor service valve gauge connectors and tighten.

1-1-58 Replace the protective cap over the Freon drum and tighten.

1-1-59 Plug the ends of the testing gauge set lines to prevent moisture for next use. CAUTION: Hand tight.

1-1-60 Recheck for leaks with leak detector.

1-1-61 Clean up work station.

1-1-62 Have instructor check completed job.

1-1-63 Answer all questions and read precautions on this job sheet. (Handout 1-1-63)

1-1-64 Evaluate (Handout 1-1-64).

STUDY QUESTIONS

AUTOMOBILE AIR CONDITIONING

1. What is meant by BTU?

2. Define the following:

   (a) heat

   (b) refrigeration

   (c) vaporization

   (d) pressure

   (e) compressor

   (f) condenser

   (g) evaporator

3. What use is the receiver in the Air Conditioning system?

4. What two functions does the expansion value serve in an air conditioning system?

5. Explain the function of the evaporator.

6. Explain the function of the condenser.

7. Name two ways of preventing the evaporator coil from icing up.

8. What is cooling?

9. What is refrigerant-12?

10. What precautions should be taken toward refrigerant-12?

1-1-64

UNIT XV

AIR CONDITIONING TEST

1. What is meant by BTU?
2. Explain the function of the condenser in an air conditioning system.
3. What is refrigerant-12?
4. What precaution should be taken toward refrigerant-12?
5. What purpose does the receiver serve in the air conditioning system?
6. Name two ways of preventing the evaporator coil from icing up.
7. Why is it necessary to have a compressor in the system?
8. What is heat?
9. Explain the function of the evaporator.
10. What is cooling?

TEST RESULTS FOR INTERIM PERFORMANCE OBJECTIVES

CLASS Power Mechanics I-N TEACHER Tom McLain DATE 7-31-72

Interim Performance Objective Number	Expected Proficiency level	Date Tested	Group Average	Number of Students Tested	Number of Students meeting the Objective
1-0-0	70%	7-28-72	68%	30	17

*NOTICE: INSTRUCTOR
SAMPLE SHEET
Be prepared to complete this form
on students performance at the end of
the last unit.*

DIRECTIONS FOR COMPLETING TEST RESULTS FOR INTERIM PERFORMANCE OBJECTIVES

A. Heading Information:

1. Class: Enter the name of the Interest Based Curriculum Area, eg. Math for Industry.
2. Teacher: Enter name of teacher. If more than one teacher is involved, give the name of the teacher managing the instructional activity.
3. Date: Enter the date of submission of the result sheet .

B. Line Item Information:

1. Interim Performance Objective Number: Enter the code number for the interim performance objective for which data are reported.
2. Expected Proficiency Level: Enter proficiency level specified in the interim performance objective.
3. Date Tested: Enter date of testing for the specified interim performance objective.
4. Group Average: Enter the average for the student group tested. Use the same statistic as specified in the interim perform ance objective proficiency level (see number 2 above), eg., if 70% is the proficiency level then group average should be specified in terms of percent correct response.
5. Number of Students Tested: Enter the number of students measured for the specified interim performance objective.
6. Number of students meeting the Objective: Enter the number of students that scored at or above the expected proficiency level as specified in number 2 above.

Example: Upon completion of this topic, students will show a basic knowledge of fractions and the termonology involved by scoring 70% on a teacher made test.

TEST RESULTS FOR INTERIM PERFORMANCE OBJECTIVES

Class Math For Industry Teacher Tom Melain Date 7/31/72

nterim Per- ormance bjective umber	Expected Proficiency Level	Date Tested	Group Average	Number of Students Tested	Number of Students meeting the objective
-0-0	70%	7/28/72	68%	30	17

TEST RESULTS FOR INTERIM PERFORMANCE OBJECTIVES

CLASS ____________________ TEACHER ____________________ DATE ______________

Interim Performance Objective Number	Expected Proficiency level	Date Tested	Group Average	Number of Students Tested	Number of Students meeting the Objective

POWER MECHANICS GLOSSARY
SHOP SAFETY
UNIT II

1. **Carbon Dioxide** (kär' bon di-ox'-ide)-(CO_2)- Product of complete combustion of carbon fuels. Used in gaseous forms as a fire extinguisher and in solid form as dry ice.

2. **Carbon Monoxide** (kär'-bon mon-ok'-sid)-(CO)- An odorless, colorless, tasteless, deadly-poisionous gas formed by incomplete combustion of carbon fuels.

3. **Creeper** (creep' ər)- A low platform supported on small casters on which an automobile repairman may lie while working under a car.

4. **Flamability** (flam' ə-bil'-i-ty)- The condition of a substance to burn easily after being exposed to air and fire.

5. **Hydraulic Jack** (hi-drô'-lik)- A device for raising weight or exerting pressure by pumping oil or other liquid under a piston or ram.

6. **Maintenance** (main'-tə -nance)- Proper care, repair, and keeping in good order.

7. **Spontaneous Comubstion** (spon-ta'-ni- əs com-bus' ch ən)- The ignition or combustion of a substance by heat generated within itself.

8. **Viscosity** (vis-kos'-ə -ti)- The friction of a liquid substance against its carrier, and its resistance to flow.

PREVENTIVE MAINTENANCE
UNIT III

1. **Shock Absorber** (shok ab-sorb' ər)- That portion of the front suspension that absorbs shock. It is usually a two-piece cylinder type mechanism operated by fluid or air.

2. **Adjust** (ad-just')- To bring about a proper arrangement of parts as regards to relation, position, fit, etc.

3. **Air-Cleaner** (klen' ər)- A device designed to separate dirt and other foreign substances from the atmosphere before it enters the combustion space.

4. **Back-up** (bak'-up)-Reverse.

5. **Battery** (bat'- ər-i)- Set of one or more electric cells that produce electric current.

6. Balancing (bal'-əns-ing)- To adjust to insure smooth and regular motions in an engine or machine.

7. Cable (ca'-bə l)- An insulated electrical conductor or group of conductors, protected by a waterproof coat.

8. Carburetor (kär' bu-ret' ər)- A device for converting liquid fuel into vapor and mixing it with air in such proportions as to form the most efficient combustible mixture.

9. Control (con-troi')- A device that regulates speed; controls.

10. Clutch (kluch)- A device placed between engine and transmission which permits the engine to run free when the left foot pedal is depressed, or to drive the car when the pedal is released.

11. Crank-case (krangk kas)- The lower part of an automobile engine which acts as a reservior for the supply of lubrecating oil.

12. Dimmer switch (dim' ər swich)- A device used to change the headlights to higher or lower beams.

13. Distributor (dis-trib'-ū-tə r)- The device, operating in fixed time with the engine, which distributes the high-tension current to the spark plugs.

14. External (eks-ter' nə l)- On the outside; outer.

15. Filter (fil'-ter)- A device consisting of choke coils and condensers used for smoothing out a varying current, eliminating, or permitting to pass, certain alternating-current frequencies.

16. Flasher (flash' ə r)- A device for flashing on and off a lamp or group of lamps as in some electric signs.

17. Fluid (flu' id)- A substance that yields to any force tending to change its form from without changing its volume.

18. Fuel pump (fu' ə l)- A device operated by a piston or diaphrogm to create vacuum which insures supply of fuel to carburetor or mixing chamber.

19. Horn (horn)- A sounding device on a car used as a warning system.

20. Lights (sealed-beams)- The combined assembly consisting of lens, reflector, and lamps in a sealed vacuum or gas container.

21. Ignition (ig-nish' ən)- The lighting of the charge in gas engines, effected generally by an electric spark.

22. Inspection (in-spek' sh ə n)- The process of examining the parts and materials of manufactured articles to insure that the specifications of manufacture have been met.

23. Lubrication (lu'-bre-kā-shən)- The act of applying lubricants.

24. Muffler (muf-lər)- A mechanical device consisting usually of a hollow cylinder attached to the exhaust pipe of a gasoline engine through which the exhaust is passed in order to partially deaden the sound.

25. Paper-element (pa-pər el'-ə-mənt)- An unsized rag paper made entirely from fibers, and used to filter dust particles from the air.

26. Polyurethane (pol'-i-yo͝or'ə-than)- A type of material in making air filters for the carburetor.

27. Positive-Control Valve (poz'-ə-tiv)- (PC)- A device to direct crankcase fuems to the carburetor or intake manifold in order that they may be burned rather than dispelled into the air as a raw fume.

28. Relay(rē'-la)- A device for opening or closing a local circuit under given conditions in a main circuit.

29. Service (ser'-vis)- That part of an electrical installation between the pole transformers and the meters and their associated equipment.

30. Signal (sig'-nəl)- Devices used to give directions.

31. Sludge (sluj)- Oily deposits such as accumulates in a crankcase.

32. Speedometer (spēd-om'-ə-tər)- An instrument for recording distance traveled and the rate of speed in miles per hour.

33. Tension (ten'-shən)- A pulling force; the opposite of compression.

TOOLS AND THEIR FUNCTIONS
UNIT IV

1. Bolt (bōlt)- A fastening; commonly a piece of metal with head and threaded body for the reception of a nut.

2. Clearance (kler'-əns)- The amount of space, open, or free, between adjustment parts.

3. Copper(kop'-ər)- A metal, soft, ductile, but not strong; of great value in the forming of alloys.

4. Device (di-vīs')- A mechanical aid or contrivance which serves to promote the better performance of a job.

5. Charging (chär'-jing)- The process of charging electrochemically the plates and electrolyte of a storage cell or battery.

6. Circuit (ser'-kit)- The course followed by an electric current passing from its source through a succession of conductors and back to its starting point.

7. Circuit breaker (ser'-kit brak'- ər)- A switch, usually automatic, which opens to stop the flow of current.

8. Condenser (kən-den'-sər)- (Mech.) A vessel in which the condensation of gases is effected. (Elec.) An accumulation of electrical energy.

9. Coil (koil)- Successive turns of insulated wire which create a magnetic field when an electric current passes through them.

10. Discharging (dis-chärj'-ing)- Rid of an electric charge; withdraw electricity from a source.

11. Disassembly (dis'-sem'-bli)- To separate the different parts of a machine or engine.

12. Generator (jen'- ər-ā-tər)- Term applied to machines which are used for the transformation of mechanical energy into electrical energy.

13. Induction (in-duk'-shən)- The production of magnetization or electrification in a body by the mere proximity of magnetized or electrical bodies, or of an electric current in a conductor by the variation of the magnetic field in its vicinity.

14. Lamp (lamp)- A device having a filament or which, when heated to incandescence, gives off light.

15. Magnetic field (mag'-nət-ik)- The space in the vicinity of a magnet through which magnetic forces act.

16. Over-haul (o'-vər hôl)- To take apart, inspect, repair, and reassemble, as a piece of machinery.

17. Regulator Voltage (reg'-u-la-tər vol'-tij)- A device of electromagnetically operated contact points and a resistance unit which, when connected in series with the field of an auto generator, reduces the generator's output when the battery reaches a predetermined voltage.

18. Rheostat (re'-ə-stat)- A device for regulating electrical current, in which the current is made to flow through wires having considerable resistance.

5. Drilling (dril'-ing)- A device very accurately made of cast or wrought iron which becomes a guide for the drilling of holes.

6. Extractor (eks-trak'-tər)- A device used to remove bolts that are broken off even with the surface.

7. Fastening (fas'-ən-ing)- Such holding devices as bolts, screws, keys, etc.

8. Heating coil (het'-ing koil)- Device used.

9. Install(in-stôl')- Placing items in position for use.

10. Iron (i'ərn)- A device used to unit, under proper heat, pieces of metal.

11. Nut (nut)- A small block of metal or other material commonly square or hexagonal in shape, having internal threads to receive a bolt.

12. Solder (sod'-ər)- An alloy used for joining metals together under heat.

13. Splicing (splīś-ing)- The process of joining two or more leads or slugs for the purpose of obtaining a length equal to their total.

14. Stud bolt (stud bōlt)- A bolt threaded at both ends with blank space between to permit gripping with a pipe wrench.

15. Tapping (tap'-ing)- The threading of a hole by means of a tap, either by hand or by machine.

16. Tolerance (tol'ər-əns)- Allowable inexactness or error in dimensions of manufactured machine parts.

ELECTRICAL SYSTEM
UNIT V

1. Accessory (ak-ses'-əri)- A mechanical part or attachment not necessarily a part of the machine with which it is to be used but does not make possible a wider range of work or better performance.

2. Adjustment (ə'-just'-ment)- The placing and setting of engine or machine parts in related position.

3. Alternator (ôl'-ter-na-tər)- An electric generator which produces alternating current.

4. Calibration (kal'-ə-bra'-shən)- Ascertaining the amount of variation from absolute accuracy in a scientific instrument.

19. Spark plug (spärk plug)- A device for conducting the high tension current to the combustion space where the charge is fired by the spark as it jumps the gap of the plug.

20. Switch (switch)- A device for opening and closing an electric circuit.

21. Timing (tim'-ing)- The adjustment of valves and crankshaft of an engine in their relative position to produce the greatest effective output in H.P. (2) The point at which ignition breaker is set in relation to top deadcenter position of the piston to secure the greatest effective expansion force upon head of piston.

22. Transistor (tran-zis'-tə r)- A compact unit performing many of the functions of vacuum tubes in electronic circuits with the advantage of small size and cool instantaneous operation.

FUEL SYSTEM
UNIT VI

1. Accelerator (ak-sel'- ə r-a-t ə r)- A mechanical device for regulating the amount of gas mixture which is fed to the engine, usually operated by foot.

2. Anti-knock (an'-ti-knock)- A substance which brings about uniform expansion of the products of combustion.

3. Carburetor barrel (kär'-bu-ra'-t ə r bar' əl)- The metal portion of the carburetor surrounding the suction air chamber forming a wall or barrel for the full length from choke to flange.

4. Carburetor (kär'-bu-ra't ə r)- A device for converting liquid fuel into vapor and mixing it with air in such proportions as to form the most efficient combustible mixture.

5. Float (flot)- (carburetor)- Usually an air tight metal container which floats on the surface of the fuel in the bowl of the carburetor and controls the flow of gasoline from the main fuel line.

6. Fuel (fu' əl)- Combustion matter, such as wood, coal, gas, or oil, which may be used to feed a fire or operate an engine.

7. Fumes (fūm)- Vapor, gas, or smoke, especially if harmful, strong or odorous.

8. Gallon (gal' ə n)- A unit of liquid measure containing 4 quarts, 8 pints, 231 cubic inches.

9. Idling Jets (i'd ling jets)- The jet which controls the amount of gas needed for operating the engine at idling speed.

10. Injector (in-ject')- A device used for affording a continuous supply of gasoline to the engine.

11. Jets (jets)- (a) A spout or nozzle; (2) That which spurts out.

12. Lean-mixture (len-miks'cher)- A fuel mixture which contains too much air in proportion to gasoline.

13. Linkage (lingk'-ij)- A device used on engines for controlling valve action.

14. Pump (pump)- A machine for lifting or forcing liquids, either by means of a bucket or of a pistion working in a closed cylinder.

15. Rich (rich)- Mixture consisting of a high proportion of fuel.

16. Super-charger (su'-per-char'j ə r)- A mechanical device designed to give position fuel mixture to racing motors and airplane motors.

17. Throttle (throt' əl)- To shut off or regulate, as steam. A device for accomplishing the same.

18. Vacuum (vak'-u ə m)- A pump used to remove condensation and air from the return main of a heating system in order to (a) create a vacuum and (b) return the condensate to the boiler or to a receiving tank.

EXHAUST SYSTEM
UNIT VII

1. Aluminum alloys (əlü'-mə -nə m al'-oi)- The combination of aluminum and other metals, such as copper, nickel, tungsten, etc., to produce castings and sheets where strength and lightness are required. These alloys are more valuable than aluminum.

2. Asbestos (as-bes'-t ə s)- A fibrous variety of amphibole distinguished by its ability to resist high temperatures and the action of acids, and capable of being spun and woven.

3. Carbon monoxide (kär'-bon mon-oks-Īd)- CO, An odorless, colorless, tasteless, deadly-poisonous gas formed by incomplete combustion of carbon fuels.

4. Condensation (kon'-den sa'sh ə n)- The change of a substance from a vapor into a liquid state to cooling.

5. Corrosion (kə rō'zhen)- The rusting or oxidation of metals by contact and chemical union with oxygen in a damp atmosphere.

6. Damper (dam'p ə r)- A plate, valve cover, or other contrivance for regulating draught.

7. Exhaust (eg-zost')- The passage through which the spent steam on an engine cylinder is carried to the outer air or to a condenser.

8. Exhause Emission Control (eg-zost' i-mish'- ən kən-trol)- A device to reduce the level of unburned hydrocarbons and carbon monoxide from the engine exhaust system.

9. Gaskets (gas'-kit)- Paper, metal,rubber, or specially prepared materials used between cylinder head and cylinder, or under similar conditions, to prevent leaking.

10. Glass pack muffler (glas pak muf'lə r)- A straight through muffler utilizing fiber glass packing around a perforated pipe to deaden exhaust sound.

11. Heat Riser (hēt riz' ər)- An area, surrounding a portion of the intake manifold, through which exhaust gases can pass to heat the fuel mixture during warm-up.

12. Leak (lēk)- A hole or crack not meant to be there that lets something in or out.

13. Manifold (man'ə fold)- A pipe or number of pipes connecting a series of holes or outlets to a common opening.

14. U Clamp (klamp)- A clamp shapped like the letter "U" used for clamping the tail pipe to the muffler.

15. Valve (valv)- A device used to either open or close an opening.

ENGINE TUNE-UP
UNIT VIII

1. Block (blok)- That part of the engine containing the cylinders.

2. Cam gear (kam gēr)- A device used to drive the camshaft.

3. Camshaft (kamshaft)- A device with lobes (bumps) used to operate the valves.

4. Clockwise (klok' wīz)- Rotation to the right as that of clock hands.

5. Counter-Clockwise (koun'tə r klok' wīz)- Rotation to the left as the opposite movement of clock hands.

6. Harmonic Balancer (här-mon'-ik bal' ə n-s ə r)- A round weighted device attached to the front of the crankshaft to minimize the torsional vibration.

7. Ignition Switch (ig-nish'- θn swich)- An electrical control which completes or breaks the circuit to ignition coil either by wiping contacts or push-[illegible] [illegible] fingers.

8. Marks (marks)- (Timing)- Marks on engine flywheel or dynamic balancer that align with pointer at the instant No. 1 cylinder is ready for fire.

9. Points (points)- A pair of removable devices that are opened and closed to break and make the primary circuit.

10. Terminal (tur'-mə-nəl)- A connecting point in an electrical circuit.

11. Top Dead Center (T.D.C.)- The extreme top position of the No. 1 piston in its cylinders.

INTRODUCTION TO INTERNAL OPERATION OF THE ENGINE
UNIT IX

1. Aligning (ə-līn'-ing)- Bringing the various parts of a unit into correct position in respect to each other or to a predetermined location.

2. Assembling (ə -sem'-bl-ing)- The putting together in correct relation of the parts which comprise a piece of mechanism.

3. Bearing (bâr-ing)- The area or unit in which the contacting surface of a revolving part rest.

4. Belts (belts)- Bands or straps of leather, canvas, or other material, flexible enough to act as a transmitter of power over smooth pulleys, acting by friction only.

5. Boring (bor'-ing)- The operation of making or finishing circular holes in wood or metal.

6. Bypass Valve (bī́-pas valv)- A valve that can open and allow a fluid to pass through in other than its normal channel.

7. Cooling system (kül-ing sis'-təm)- Those devices which prevent the overheating of the engine by rapidly carrying off the heat generated by combustion. Radiators, fans, pump and water jackets are parts of a water-cooling system.

8. Combustion (kəm-bus'-chən)- The process involved during burning.

9. Connecting Rod (kə -nek'-ting)- The connecting link between the piston and the crankshaft.

10. Cylinder (sil'- ən-dər)- The hole, or holes, in the cylinder block that contain the pistons.

11. Cylinder Block (sil'- ən-dər blok)- The main body of the engine which is bored to receive the pistons. The cylinder block and crankcase are frequently cast as one piece.

12. Cylinder Head (sil'- ən-dər hed)- The metal section that is bolted on top of the block. It is used to cover the tops of the cylinders.

13. Design (di-zīn)- A plan or sketch made to serve as a pattern from which to work; a design for a machine.

14. Drive Belts (drīv belts)- Bands or straps which are strong and flexible to act as a transmitter of power over smooth pulleys, acting by friction only.

15. Frame (frām)- The unit which include all parts of the car except the body. The chasis.

16. Flywheel (flī-hwel)- A heavy wheel used in machinery where reciprocal motion is converted into circular motion.

17. Honing (hōn'-ing)- Removing metal with a fine grit abrasive stone to precise tolerance.

18. Journal (jer'nəl)- The support portion of a shaft, that part which revolves in the bearing.

19. Lifters (lif'tər)- (Hydraulic)- A valve lifter that utilizes hydraulic pressure from the engine's oiling system to keep it in constant contact with both the camshaft and the valve stem.

20. Lubrication (lu'-brə -kā'-shən)- The act of applying lubricants.

21. Mechanism (mek'-ə -níz- əm)- Means or ways by which something is done; technique.

22. Micrometer (mī-krom'-ə-tər)- A precision measuring tool that will give readings accurately with a fraction of one thousandth of an inch.

23. Offset (of'-set')- A connecting rod which is bent in two places, may show the piston pin to be parallel to the bearing when tested on an aligner. Such a rod will be offset.

24. Pin (pin)- (Piston pin or wrist pin)- A steel pin that is passed through the piston.

25. Piston (pis'tən)- A round plug, open at one end, that slides up and down in the cylinder. It is attached to the connecting rod, when the fuel charge is fired, will transfer the force of the explosion to the connecting rod then to the crankshaft.

26. Piston rings (pis'-tən rings)- A splint ring installed in a groove in the p[illegible]

27. Re-conditioning (rē-kən-dish'- ən-ing)- To adjust and repair so as to be usable.

28. Rocker-arms (rok'- ər)- An arm used to direct the upper motion of the push rod into a downward or opening motion of the valve stem.

29. Rotation [illegible]'-shən)-Turning, or causing to turn or revolve, as on [illegible]

30. Scaling (skal ing)- The accumulation of rust and minerals within the cooling system.

31. Servicing (ser'vis-ing)- A term used to denote normal maintenance of a car, washing, greasing, etc.

32. Sl[illegible]-ing)- A hollow tube or cylinder which surrounds a rod or shaft.

33. Tapping (tap'-ing)- The threading of a hole by means of a tap, either by hand or by a machine.

34. Thermastats (ther'-mə stat)- A temperature sensitîve device used in the cooling system to control the flow of collant in to the temperature.

35. Threads (threds)- (screw)- Projections left by cutting a helical groove on a cylinder.

36. Value Seats (val'-u sēts)- That part of the engine block machine to receive the poppet valve and provides a seal against leakage of gases.

37. Value Springs (val'-u springs)- A compression-type spring exerting pressure of 40 to 90 pounds to keep valves in closed position.

38. Ventilators (ven'-tə lā'tərs)- A device for providing fresh air; exhausting foul air.

BRAKING SYSTEM
UNIT X

1. Bleeding (bled-ing)- The Brakes- This refers to the removal of air from the hydraulic system.

2. Brakes (brāks)- Anything to use to check motion of a wheel or vehicle by pressing or strapping.

3. Brake Cylinder (brāk sil'- θn-dər)- (Wheel cylinder)- The part of the hydraulic brake system that receives pressure from the master cylinder and in turn applies the brake shoes to the drums.

4. Brake-Disc Type (brāk disk tīp)- A braking system that instead of using the conventional brake drum with internal brake shoes, uses a steel disc with caliper type lining application. When the brakes are applied, a section of lining on each side of the spinning disc is forced against the disc, thus imparting a braking force.

5. Brake Lining (brāk līn'-ing)- A friction material fastened to the brake shoes. It is pressed against the rotating brake drum, thus stopping the car.

6. Brake Pedal (brāk ped'- əl)- The foot pedal which controls the application of brakes.

7. Brake Power (brak pow' ər)- A conventional hydraulic brake system and utilizes engine vacuum to operate a vacuum power piston.

8. Brake Shoes (brāk shüs)- That part of the brake system located at the wheels, upon which the brake lining is attached. When the wheel cylinders are actuated by hydraulic pressure, they force the brake shoes apart and bring the lining into contact with the drum.

9. Diaphragm (dī' əfram)- A flexible cloth-rubber sheet that is stretched across and on an area thereby separating two different compartments.

10. Fluid Brakes (flü'-id brāks)- A special fluid used in hydraulic brake systems.

FRONT SUSPENSION
UNIT XI

1. Absorbers (shock) (ab-sôrb' ər)- An oil filled device used to control spring oscillation in the suspension system.

2. Coil Spring (koil spring)- A section of spring steel rod wound in a spiral pattern or shape. Widely used in both front and rear suspension systems.

3. Front Alignment (frunt ə -lin'-m nt)- To bring the various parts of a unit into the correct positions in respect to each other or to a predetermined location.

4. Linkage (lingk'-ig)- Movable bars or links connecting one unit to another.

5. Power Steering (pow'- ər ster-ing)- A steering system utilizing hydraulic pressure to increase the driver's turning effort.

6. Rotary Valve (ro'-t∂ -ri valv)- A device that relives all spring pressure so that it is free to rotate.

7. Sleeve (slēv)- A hollow tube or cylinder which surrounds a rod or shaft.

8. Stablizer Bar (sta'-bθ -liz'- ər bãr)- A transverse mounted spring steel bar that controls and minimizes body lean or tipping on corners.

9. Steer (stēr)- A term applied to the guiding of a course: steer a car, steer an airplane.

10. Suspension (s ə s-pen'-sh ə n)- Arrangement of springs for supporting the body of an automobile, railroad car, etc.

11. Tie-Rod (tī rod)- The transverse rod connecting the front wheels of an automobile in order to permit them to act as a unit in steering.

12. Toe-in (tō in)- Relates to the setting of the front wheels so that they will be 1/8 to ½ inch closer together at the front than at the rear.

13. Toe-Out (tō out)- Having the front of the wheels further apart than the back.

14. Torsion (tôr'-sh ə n)- The act of twisting. The tendency to deform as a rod, by twisting.

15. Vane (vān)- A thin plate that is affixed to a rotatable unit to either throw off air or liquid, or to receive the thrust imparted by both moving air or liquid striking the vane. In the first case, it would be acting as a pump and in the second case, as a turbine.

TRANSMISSION
UNIT XII

1. Automatic (ô-t-mat'-ik)- Self-regulating or self-adjusting.

2. Bearings (bair'-ing)- The area or unit in which the contacting surface of a revolving part rests.

3. Cast Iron (cast iron)- Iron of ordinary use, cast molds; has high carbon content; cannot be rolled, forged, or tempered.

4. Clutch (kluch)- A device used to connect or disconnect the flow of power from one unit to another.

5. Governor (guv'- ər- n ər)- A device for regulating the speed of engines and machines.

6. Manual (man'-ū- əl)- Operated by the hand. That which is done by the hand.

7. Overdrive (ō'-vər- driv')- An arrangement of gears whereby even more speed and less power are produced than in high.

8. Parking Linkage (park'-in link'-ij)- A device to engage the parking gear of the transmission connected between the transmission and the shift lever.

9. Pinnion Gear (pin'-yən gēr)- The smaller gear of a pair, either level or spur, regardless of size.

10. Powerflite (pow'- ər flīt)- An automatic transmission supplied on cars built by Chrysler Corp.

11. Pump (pump)- A machine for lifting or forcing liquids, either by means of a bucket or of a piston working in a closed cylinder.

12. Synchromesh Transmission (sing'-krə -mesh trans-mish'- ən)- A mechanical device designed to make gear shifting easy or silent.

13. R.P.M.- Revolutions Per Minute.

14. Thrust Washers (thrust wash'- ərs)- A bronze or a hardened steel washer placed between two moving parts. The washer prevents longitudinal movement and provides a bearing surface for the thrust surfaces of the parts.

15. Torque (tôrk)- Turning or twisting force, such as the force imparted on the drive line by the engine.

16. Torque Converter (tôrk kən-vėrt'- ər)- A unit quite similar to the fluid coupling, that transfers engine torque to the transmission input shaft.

17. Transmission (trans-mish'- ən)- A device that uses gearing or torque conversion to effect a change in the ratio between engine RPM and driving RPM.

DRIVE LINE
UNIT XIII

1. Flange Bearing (flang bãr'-ing)- The turned edge of a metal shape or plate, which resists bending strain.

2. Parking (pärk'-ing)- Leaving an automobile for a time in a certain place.

3. Snap Ring (snap ring)- A split ring that is snapped in a shaft or in a groove in a hole. It is used to hold barrings, gears, etc., in place.

4. Spider Gear (spī'-d θr gēr)- The two, three, or four gears (as the case may be) fitted free running on the spider, by means of which differential action is obtained in the gear axle.

DIFFERENTIAL
UNIT XIV

1. Alignment (ə-lin'-ment)- To bring the various parts of a unit into correct positions in respect to each other to a predetermined location.

2. Carrier (kar'-i-ər)- Same as lathe dog. The most common form is clamped on in the faceplate causing rotation of the piece. The cylindrical piece will be turned and has a projecting tail which is engaged in a slot.

3. Joint (joint)- To join. fasten, or secure two or more pieces together.

4. Propellor (prə-pel'-ər) (shaft)- The shaft connecting the transmission output shaft to the differential pinnion shaft.

5. Sure-grip (shűr' grip)- A device for grasping or holding.

6. Trunnion (trun'-y-θn)- One of two opposite cylindrical supporting lugs or projections from the side of an object, which allows it to be turned on an axis.

7. Universal Joint (u'-nθ-ver'-səl joint)- A type of coupling which permits the free rotation of two shafts whose axes are not in a straight line.

8. Velocity (vθ-los'-θ-ti)- It is the distance divided by time, and is expressed in feet per second or per minute.

AIR-CONDITIONING
UNIT XV

1. Compressor (kəm-pres'-ər)- A device that draws in low pressure refigerant from the evaporator and compress it.

2. Freon (frē'-on)- Dichlorodifluromethane. Used as a refrigerant. A gas used as the cooling medium in air conditioning and refrigeration systems.

3. Refrigerant (ri-frij'-ər-ənt)- The liquid in refrigeration systems to remove heat from the evaporator coils and carry it to the condenser.

4. Refrigeration (ri-frij'-ərā'-shən)- Act or process of cooling or keeping cold.

5. Temperature (tem'-per-ə-chər)- Degree of heat or cold.

6. Wet Sleeve (wet slēv)- A cylinder sleeve application in which the water in the cooling system contacts a major portion of the sleeve itself.

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DIRECTIONS FOR COMPLETING MONITORIAL SHEET

A. Heading Information:

1. Class: Enter the name of the Interest-Based Curriculum Area, eg. Math For Industry.

2. Teacher: Enter name of teacher. If more than one teacher is involved, give the name of the teacher managing the instructional activity.

3. Date: Enter the date of submission of the monitorial sheet.

4. Objectives (By Number): Enter the numbers of the interim-performance objectives covered by the monitorial sheet. Process and task level objectives should not be entered in this area of the form.

5. Time Interval: Specify the beginning and ending dates for the industrial activities covered on the particular monitorial sheet.

B. Line Item Information:

1. Objectives: Enter the number(s) of the process/task level objectives implemented to bring about the behaviors specified in the interim-performance objectives noted in A-4 above. Do not specify interim-performance objectives at the line item level.

2. Estimated Time: Enter the estimated time for completion of each process/task objective. This should be noted in terms of days to the nearest tenth. One day is equivalent to the instructional activity period for the given curriculum area for a single group of students.

3. Actual Time: Same as #2 above in terms of actual days and tenths of days utilized to carry out the line item objective.

4. Date Completed: Date of completion of the instructional activity.

5. Teacher's Initials: Initial each line item to signify completion of the instructional activity.

C. Additional Information:

1. Objectives Not Covered (List By Number): List those process/task objectives not implemented in the instructional activities for the given interim-performance objectives.

2. Objectives Altered or Added (List By Number; State Adjusted Objective on Back of Sheet): Complete as specified.

Natchitoches Central High School
Natchitoches, Louisiana

Monitorial Sheet

Class________________ Teacher____________________ Date__________

Objectives (By Number)____

Time Interval: ____

Objectives	Estimated Time	Actual Time	Date Covered	Teacher's Initials

Objectives Not Covered (List By Number)______________________________

____

Objectives Altered or Added (List By Number; State Adjusted Objective on Back of Sheet)____

____